The FOUNDRY

Volume 50
Number 17

Published
Semimonthly

CLEVELAND, OHIO, SEPTEMBER 1, 1922

Set Core Mixture Standards

Extensive Research Work Has Been Carried on To Determine the Most Economical Method for Producing Cores Destined for Use in Small Molds for Brass and Malleable Iron Castings

BY PAT DWYER

STARTING in a modest plant with 15 employes in 1888, the Ohio Brass Co., Mansfield, O., steadily has expanded until today it does a business of from $6,000,000 to $8,000,000 a year, employs 2000 men and the buildings in the main plant cover 8½ acres. A modern malleable iron foundry having a potential capacity of 60 tons of castings a day recently has been erected and equipped on the Mansfield property to take care of its requirements in that line and in addition, the company maintains an extensive factory in Barberton, O., devoted to the production of crockery insulators. As was noted in a previous article, this company manufactures a complete line of electrical sundries. Many contributing factors have been responsible for the continued growth and expansion of the company and not least among them must be reckoned the company's policy of maintaining an extensive technical and engineering staff which devotes its time, not only to improving existing methods and processes, but also to research work designed to develop new avenues for the company's product. Times change, people and markets change with them and the successful manufacturer not only meets the present demand, but anticipates the demands of the future. The engineering and testing offices are lo-

FIG. 1—A PNEUMATIC TOOL HELD FIRMLY AGAINST THE GATE EFFECTUALLY REMOVES ALL THE CORE SAND FROM THE CASTINGS

cated on the second floor of a building adjoining the core room end of the foundry while the chemical laboratory is on the second floor of the general office building. Forging, stamping, welding, heat-treating, galvanizing and assembling departments all present points of interest, but the scope of this article does not extend beyond the foundry and pattern shop.

Referring to a general view of the greater part of the foundry floor shown in Fig. 2 it will be noted that the molding floors cover three sides of a hollow square. The furnaces occupy the greater part of the center space which also embraces the fourth side of the square. Practically all the castings are made on 48 molding machines, power and hand squeezers of various types and sizes arranged in relation to the molding stands as shown in the illustration. A wooden partition, surmounted by a bench separates each floor from its neighbor. In addition to the bench, each floor is provided with an open, pipe-work frame on which the molder's cores are placed in boxes ready to his hand. With the exception of the flasks which he carries from the machine to the pouring stands, everything else he needs is carried to him.

Three pouring stands are provided on each floor and as pouring goes on continuously all day, the molds on each floor are poured before the three stands are filled. The stands are constructed of angle irons attached to 4 legs or brackets and braced by a long tie rod extending from end to end along the bottom. One side of the stand is higher than the other so that the molds may be poured while on a slight slant. A closer view of several floors nearly filled with molds ready for pouring is shown in Fig. 5. Details of one of the pipe stands for holding boxes of cores, snap flasks, etc., are shown to the extreme left of the same illustration. All the castings are made in snap flasks and the necessary reinforcement to prevent the molds from bursting under the pressure of the molten metal is supplied either by shallow bands placed inside the empty snap flask and rammed up with the mold, or by iron jackets slipped half way down on the molds after they are closed. Examples of the former are shown stacked in piles across the middle fore ground in Fig. 2 while the latter are shown in place on the molds shown in Fig. 5.

The melting equipment partly visible in Fig. 2, comprises one 1-ton electric furnace; 8 pit-type, oil-fired crucible furnaces in which 150-pound crucibles are employed; and 6 oil-fired, revolving, direct flame furnaces each capable of melting 800 pounds at a charge. From 30,000 to 50,000 pounds of metal are melted daily of which approximately 60 per cent is absorbed by castings and the remaining 40 per cent is represented by gates, sprues, scrap and furnace loss. The number of individual melting units affords wide opportunities for producing a diversified line of mixtures in any one day; while, if necessary, they may be arranged in groups for mass production on any particular class of castings.

In addition to the usual windows along both sides and both ends of the building, a row on each side of a monitor type roof affords satisfactory working light over all parts of the floor. The windows on the roof are swung on pivots and may be opened or closed to facilitate ventilation. The steam and smoke evolved in pouring the molds in a brass foundry is dissipated quickly, partly because the castings are fairly light and partly because they are shaken out immediately after they are poured and then removed to the cleaning department. The smoke and fumes from the melting furnaces present a more difficult problem. In the old fashioned, coke-fired, pit furnace with direct draft to a suitable smokestack, this feature is not a serious factor in contaminating

FIG. 2—THE MOLDING FLOORS ARE ARRANGED AROUND THREE SIDES OF A HOLLOW SQUARE WITH THE MELTING EQUIPMENT OCCUPYING PART OF THE CENTER AND THE FOURTH SIDE

the atmosphere, but in several types of modern installations the contrary is true.

Many methods have been devised for removing smoke and fumes incident to melting red and yellow brass. The method adopted at the foundry of the Ohio Brass Co., is shown at the upper left of the illustration Fig. 2. It has proved fairly efficient, but further refinements and improvements are in contemplation. By referring to the illustration it will be noted that the entire battery of furnaces with the single exception of the electric furnace, is located under an immense hood made of corrugated iron sheets. The greater part of the smoke, hot air and gas collects under this hood and is drawn through two large pipes on the top and discharged on the outside of the building by exhaust fans. The electric furnace is not operated regularly and up to the present no special equipment has been provided to exhaust the smoke. Primarily, the furnaces were grouped to conserve floor space and also because the arrangement afforded the readiest means for distributing the metal to the various molding floors. Some of the floors are closer to the furnaces than others, but none is so close that the molders are discommoded by the heat and none is so far away that the metal cools before it is poured into the waiting molds. The building is heated in winter by hot air circulated through a large main and discharged through down coming branches attached to the walls, each provided with a discharge opening about 8 feet above the floor line.

Cleaning the Castings

The bulk of the product of this foundry is made up of valves, fittings and equipment for electrically operated traction systems. Cores enter extensively into the manufacture of castings of this character and increase the cost of production to a point corresponding with their extent and intricacy. Interesting features in connection with coreroom practice and investigation will be touched upon later. At present we shall follow the castings through the cleaning room. From the collection trucks they are placed on the device shown in Fig. 1, where a workman with a pneumatic hammer knocks the cores out. From 5 to 10 seconds vibration empties the sand from each gate of castings. The sand and wires fall onto a long screen where the dust drops through and a magnet is employed to salvage the wires and nails. The castings are taken into an adjoining room equipped with one revolving sand blast table and two cabinets, supplied by the Pangborn Corp., Hagerstown, Md. These may be operated singly or together. From the sand blast room the castings are taken to a battery of double grinders and sprue cutters, and finally to the sorting and inspection benches where they are prepared for shipment either to the warehouse or to the assembling department, if they are destined to form an integral part of some form of finished equipment in which the company specializes.

FIG. 4—ONE OIL AND TWO ELECTRICALLY HEATED OVENS ARE EMPLOYED FOR DRYING THE CORES

FIG. 3—CORES ARE MADE AND BAKED ON THE SECOND FLOOR AT ONE END OF THE FOUNDRY

The small scrap from the foundry and cleaning room, mixed as it is with sand and dirt, is shoveled up just as it comes and passed through a concentrator consisting of a revolving screen and a set of riffle plates. The material is dumped into a pocket in the floor from which it is taken in a bucket elevator and discharged into a revolving screen where the larger pieces of metal are caught and afterward discharged through the open end of the screen into a box placed there for that purpose. The sand and light particles of metal pass through the screen and fall onto a corrugated table over which a stream of water constantly is flowing. Owing to difference in the specific gravity, the sand is carried all the way across the plate and falls into a trough at the side, while the metal gradually works along the corrugations in the plate, finally dicharging over the end into a receptacle set there to receive it. Turnings from the machine and finishing shops and other forms of all metallic scrap are passed over a magnetic separator.

Mixing The Metal

Analyses are made of all the reclaimed metals and with this information available the melter may add what new metals are necessary to bring any given mixture up to a predetermined standard. Even with the greatest precaution, a certain amount of foreign matter adheres to this miscellaneous scrap and various fluxing agents are employed to remove it in the form of slag after the metal has melted.

A space at the opposite end of the foundry from the cleaning room is devoted to core storage, inspection and distribution. An oven is provided in one corner for drying the sand before it is delivered upstairs to the coremakers. Exact and careful su-

Table I

Laboratory Tests on Oil Bound Cores

No.	Loss in Weight, G.	Wt. of Green Core, G.	Water, G.	Carbon Dioxide, G.	*Air Used, C.c.	Oxygen Used, C.c.	O Used per G. of Oil, G.	Temp. Range, Deg. F.	Mean Temp. Deg. F.	Breaking Strength, G.
1	8.371	0.420	0.113	0.140	767 1,000	115	1.55	475-530	500	127
2	8.524	0.431	0.094	0.107	656 990	108	1.43	440-540	500	257
3	8.339	0.413	0.306	0.042	656	82	1.11	470-520	478	326
4	8.431	0.402	0.372	0.030	648	74	0.99	348-360	452	523
5	8.314	0.420	0.210	0.034	664	69	0.94	418-432	422	612
6	8.491	0.391	0.361	0.028	633	68	0.90	420-442	422	523
7	8.342	0.451	0.224	0.031	651	66	0.89	420-440	425	457
8	8.378	0.408	0.106	0.053	620 1,070	65	0.87	380-410	400	585
9	8.196	0.392	0.169	0.018	648	52	0.71	361-378	365	775
10	8.529	0.380	0.175	0.018	676	49	0.65	368-388	377	672
11	8.535	0.431	0.307	0.010	633	35	0.47	350-374	360	613
12	8.375	0.390	0.289	0.021	620	32	0.43	358-384	370	590
13	8.915	0.346	0.056	0.013	892 1,160	34	0.43	300-335	315	359
14	8.934	0.408	0.428	0.007	199 672	31	0.39	380-398	390	588
15	8.287	0.343	0.074	0.018	787 1,070	29	0.39	280-320	300	466
16	8.776	0.411	0.411	0.012	115 642	24	0.31	380-398	389	265
17	8.681	0.381	....	0.006	622	24	0.31	338-342	340	133
18	8.861	0.401	0.435	0.010	122 650	23	0.29	380-404	391	329

*When two numbers for "Air Used" are given in the table, the upper one indicates the number of cc. air admitted or passed over the core while it was baking.

pervision is exercised over making the cores, as a basis on which to work, it is essential that all the sand entering into the various mixtures should be absolutely dry before beginning operations. Part of the space at this end of the foundry has been partitioned off to serve as a pattern storage for the thousands of patterns and pattern plates. The plates are parked in long orderly rows on shelves numbered and indexed in such a manner that any one may be secured at any time with a minimum of trouble.

Making the Cores

A general view of the coreroom located on the second floor, showing the arrangement of the benches, is presented in Fig. 3. Three core ovens, shown in Fig. 4, are provided for drying the cores. The oven at the left of the illustration is heated by oil and the remaining two ovens are heated by electric current. Comparison between the two types of ovens taken from many angles would seem to indicate that while the electric oven has many commendable features it costs more to operate than the oil fired oven of equal capacity.

In a paper published in *Chemical and Metallurgical Engineering* Oct. 26, 1921, A. A. Grub and U. S. Jamieson, director of laboratory and chief chemist, respectively, for the Ohio Brass Co., set forth the results of a series of experiments to determine the quantity of air which should be supplied and the quantity of oxygen actually used in thoroughly baking cores bonded with linseed oil. Following are salient points touched upon together with conclusions drawn by the authors.

Ventilating an electric oven presents a different problem from that involved where the oven is heated by coal, coke, oil or gas. The hot gases from the burning fuel, containing a large percentage of uncombined oxygen pass over the cores thereby providing an excess of oxygen over the quantity required in the baking process. The ventilation required to maintain proper combustion in an oven of that character always is sufficient to carry any water vaper and other gases that may be formed, out of the oven. The heating element in an electric oven is not dependent on ventilation. Any air passed through the oven is for the sole purpose of carrying off the gases and supplying oxygen. An excess of ventilation only results in loss of expensive heat energy.

Proper Quantity of Air

The proper quantity of air required to bake cores is determined by two factors: the moisture coming off the cores must be diluted or carried out of the oven and sufficient oxygen must be supplied properly to oxidize the oil. Linseed oil differs from water soluble binders in that its hardening in the core in the process of baking depends on oxidation rather than upon merely losing moisture. Water is used with oil in green core sand to improve the green bond properties and permit the sand to be packed closely enough for the oil to cement the contact points together. In sands containing clay or other natural bond, the water also serves to form a sort of plaster of this bonding material so that upon drying the grains of sand are cemented together. Each 100 pounds of green core sand contains about 6 pounds of water which expands to about 165 cubic feet at a temperature of 212 degrees Fahr. and to still greater volumes at higher temperatures. The steam practically would drive all the air from the oven or at least dilute is to such an extent that the oxygen remain-

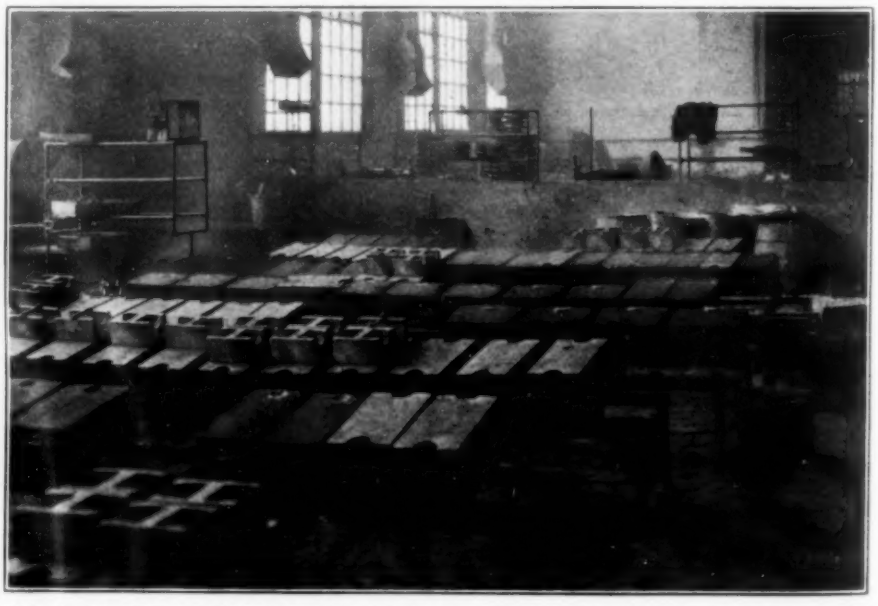


FIG. 5—SO FAR AS POSSIBLE THE RUNNERS ARE ARRANGED AT THE ENDS OF THE MOLDS TO FACILITATE POURING—MOLDS ARE SET UP ON STANDS FOR THE SAME REASON

ing would not suffice for the bake were it not for the admission of fresh air through ventilating ports or openings, in the vicinity of the door. Practically all the oxidation takes place during the latter half of the bake and therefore the need for air is not imperative until after all the water has been vaporized and the temperature has raised to near the maximum point.

The first series of tests were carried out in the laboratory and later an attempt was made to check the results by a series of tests in the core room, using the electric oven for the purpose.

Core Tests

Core sand used in the various tests was one of the standard mixtures used in the core room. It consisted of 70 volumes Michigan City Lake sand, 30 volumes sandblast dust, 8 volumes water and 2 volumes raw linseed oil. According to weight such a mixture is 5.05 per cent water and 1.18 per cent linseed oil. All of the test cores made in the laboratory, 3 inches long and of uniform cross section, were baked for 45 minutes. The accompanying Table I shows the results of 18 tests, together with some of the calculated results. They are arranged according to the quantity of oxygen absorbed per gram of linseed oil in the core. In addition to the tests recorded, two cores were baked in an atmosphere of carbon dixoide. They were of a grayish color and so weak that they scarcely could be supported on the fingers. The average baking temperature was 393 degrees Fahr. and the average breaking strength was 612 grams. A breaking strength of less than 450 grams indicted cores that would be unsatisfactory for general foundry use on account of their fragility, while results over 600 grams indicate strong substantial cores.

The oven employed in the plant test had a volume of 350 cubic feet and was equipped with a fan and ventilating device so arranged that the air in the oven could be recirculated or fresh air could be introduced from outside. Five bakes were made, each time varying the quantity of air introduced. After the cores were baked and cooled they were broken on a Wadsworth testing machine. A breaking strength of 40 pounds indicates a fair core, over 60 pounds an exceedingly strong core. A summary of the results is shown in the accompanying Table II. The test cores differed but little in strength. Evidently it was impossible to cut the air supply down to a point that would seriously affect the strength of the cores. Either there was enough air in the oven or enough leaked in around the doors to supply the necessary amount of oxygen.

Table H

Tests on Cores Baked in Foundry Oven

	Weight of cores, pounds	Time in oven minutes	Fan re-circulating, minutes	Fan exhausting, minutes	Air admitted to cores, pounds	Average strength, pounds
1	300	68	12	3	85	55
2	287	65	12	3	40	61
3	320	70	15	0	17	54
4	312	78	0	0	17	52
5	337	70	0	1	40	53

To bake cores properly when bonded with linseed oil, at least one pound of oxygen should be supplied for each pound of linseed oil in the core, this means 4.5 pounds or 60 cubic feet of fresh air. A properly baked core is more than dried. A core that is merely dried out shows a greenish tinge. Metal cast around a core of that character will blow, and the core instead of becoming fragile and easy to remove will bake hard in the casting. Linseed oil cores when baked to a decided brown color, usually can be knocked out of the casting without trouble. In core baking the oxidation process is carried beyond the drying stage, the oil actually is burned to a slight degree.

Pattern Shop Complete

A large and well equipped pattern shop is maintained for producing both wood and metal patterns. Nearly all the patterns employed in the foundry are made of composition metal, brass, or iron and therefore the wooden patterns mainly are in the form of master patterns provided with double shrinkage. A device for mounting several small patterns on a plate and in such relation to a center line that both cope and drag of a mold may be rammed on the same plate, is shown in Fig. 6. It is an adaptation of the cast-iron transfer plate process but presents many points of superiority in adaptability, ease of application and accuracy. Briefly stated the two du-

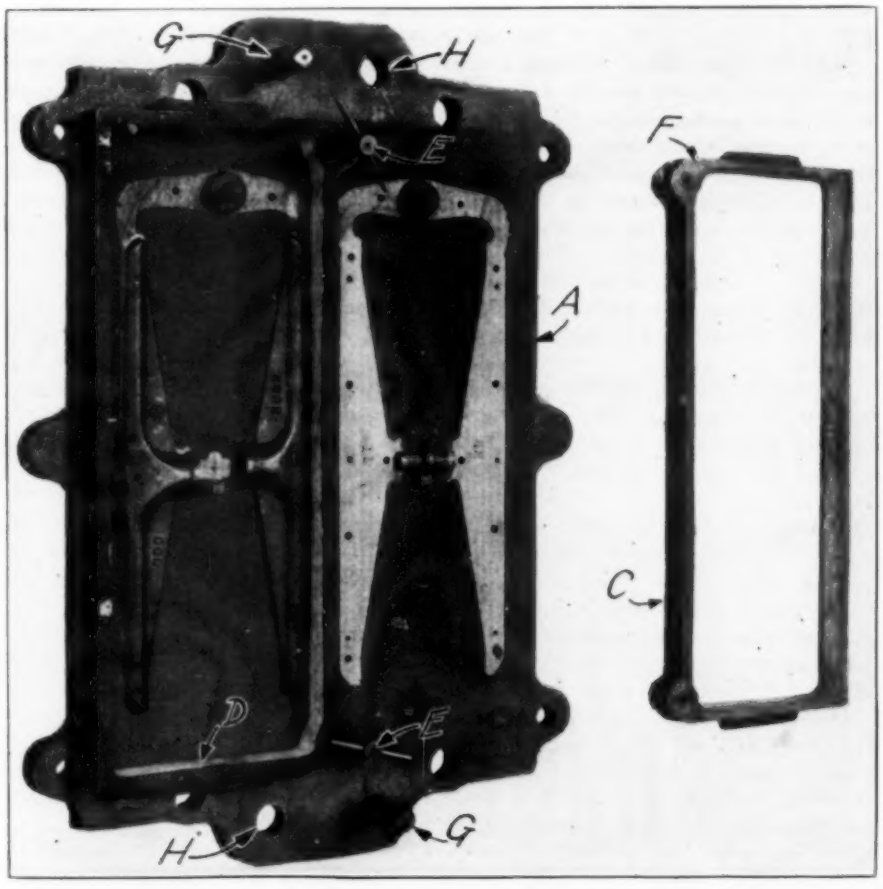


FIG. 6—TWO FRAMES FILLED WITH PLASTER OF PARIS ARE EMPLOYED FOR LOCATING PATTERNS ON PLATES DESIGNED TO FORM BOTH COPE AND DRAG OF A MOLD—THIS METHOD REPRESENTS QUITE AN IMPROVEMENT ON THE IRON TRANSFER PLATE

plicate frames *C* and *D* are filled with plaster of Paris and take the place of the transfer plate. A detailed description presents many points of interest.

It is apparent that if one half of a symmetrical split pattern is mounted on a plate all the half molds made from that plate will be alike. However, unless the half pattern is mounted definitely in relation to two lines, one drawn longitudinally and the other transversely, at right angles to each other and crossing in the center of the plate, it will be impossible to ram the other halves of the molds on the same plate. Of course, the advantage of using one plate lies in the fact that the molder can make drags and copes alternately without losing time over a pattern change. The method also is applicable in mounting patterns for cope and drag on adjoining machines where conditions warrant such an arrangement.

Wooden Master Pattern

The heavy cast iron plate *A* is provided with reinforcing ribs on the back. The face is machined to a true plane, after which a number of holes are drilled, through which it may be bolted to the machine in the foundry. A longitudinal center line then is scribed on the face and two pin holes drilled at each end to locate the flasks. Either the flask itself or a suitable jig is employed to locate these holes on either side of the center line. One of these holes at each end is smaller than the other and later pins, provided with shoulders, are fastened on these holes by nuts on the lower side. The larger hole at each end is made a loose sliding fit for the cope pins. In the illustration, the holes *H* guide the cope half of the flask into place and the pins *G* guide the drags. This is not an arbitrary arrangement, but may be varied to suit the position of pins on any type of flask. With possible slight variations, due to pattern design, the following description applies to fitting up any patterns in the manner shown in the illustration.

A wooden master pattern is made, split in the usual manner. Only half patterns are to be cast in metal, but even in cases where both halves of the pattern are symmetrical and interchangeable it usually is just as easy to make a whole wood pattern split in halves, as it is to make a half pattern. Further, in the event that a considerable number of metal patterns are wanted, as for instance in the gates of patterns shown in Fig. 1, two half wood patterns will expedite the job faster than one. The metal half patterns are molded carefully and poured from the one ladle to insure uniform contraction and also to minimize the necessary finishing.

The half patterns are surfaced on the joint side then matched in pairs and marked by a small prick punch or any other suitable manner so that they may retain their identity throughout all the succeeding operations. Theoretically all the halves are alike, but usually, minor points of difference develop and for that reason it is advisable to keep each originally marked pair together. The half patterns are sweated together and finished to the required dimensions. If convenient, all circular sections are finished in the lathe. Two, three or more small holes are drilled completely through both halves of the pattern to serve as dowel holes. The usual precautions are observed to drill these holes as nearly vertical as possible, or in other words perpendicular to the pattern parting plane.

The patterns are once more separated into halves and one set of halves placed in any desired position on one side of the center line on the plate. The corresponding halves of the patterns are placed temporarily out of the way. Any number of patterns within the capacity of the flask may be attached in this manner. We shall assume that two are used as shown in the illustration Fig. 6. The distinctive feature of this method now is brought into play. The frame *D* accurately planed on both sides, is guided into place on the plate by the pins *E E* which fit in corresponding holes drilled accurately on the center line. This frame corresponds in a general, but not necessarily accurate, manner to the length and half the width of the flask to be employed in the foundry. Plugs, long enough to extend above the top of the frame, are inserted in the dowel holes in the pattern and then the frame is filled with plaster of paris. Before the plaster is poured the plate and patterns are painted with vaseline to prevent the plaster from sticking.

After the plaster has set, the dowel hole plugs are removed. The patterns are anchored firmly on the plate and while in that position a drill is employed to continue the dowel holes in the pattern into the iron plate. In this manner the future position of the patterns on the plate is assured. However, at this point they have not served their full purpose. The guide pins are removed and the frame containing the patterns bedded in the plaster is lifted, turned over and laid upon its back on the work bench. The complementary half of each pattern, recognizable through the identifying marks previously referred to, is located in place by inserting pieces of rod the proper diameter to form a tight fit, through the upper and into the lower dowel holes in the pattern. The joint and patterns are painted with vaseline and then the second frame *C* is set on in the same manner as any ordinary cope. It is filled with plaster and after the plaster has set the frame containing the plaster and upper halves of the patterns is lifted off and placed face down on the right hand side of the cast-iron pattern plate. The same pins employed in locating the first frame, are employed to locate the second frame. The dowel pin rods are removed and as in the first instance a drill is employed to continue the holes in the patterns down into the cast-iron plate. The frame then is lifted off for the last time, turned over and laid upon its back. The patterns are removed from the plaster, relocated on the plate by the dowel holes. Tight fitting pins are driven into the holes to attach the patterns to the plate and after the gate and sprue are attached and a few minor adjustments made, the job is ready to go into production.

Frames Used Indefinitely

After the frames *C* and *D* have served their purpose, the plaster is knocked out and they are ready to be used again upon another pattern or set of patterns. Among the many advantages of this method over the usual transfer methods, perhaps the feature connected with drilling the various holes will appeal to the greater number of men who want to mount patterns in this manner. With the familiar cast-iron transfer plate, the most extreme accuracy in drilling the holes is essential to success. If every one is not absolutely perpendicular to the parting plane, trouble will be experienced in fitting the second halves of the patterns on the plate, and afterward the cope and drag halves of the mold will not match. With the plaster transfer a fair degree of accuracy is desirable in drilling the holes, but at the same time a slight deviation will not affect the relative position of the patterns.

Instances arise where it may be necessary to arrange four patterns, or four groups of patterns, on one plate. Two lines are drawn at right angles across the center of the plate. One hole is drilled at the point of intersection and a similar hole drilled on each line at a point corresponding in a general way with the boundary line of the flask to be employed. Instead of using frames half the width of the plate as in the foregoing example, a pair of frames large enough to cover only ¼ of the plate are provided. Details of fitting the patterns, filling the frames with plaster, etc., are the same as already described.

Used Loam and Green Sand

Lack of Adequate Flask Equipment Resulted in the Adoption of a Mold Made Partly in Loam and Partly in Green Sand for a Gas Engine Bed Plate

BY J. H. EASTHAM

CONDITIONS at times in every foundry, in some more frequently than in others test the skill and knowledge of the man in charge to successfully meet a difficult and unusual situation. Makeshift methods are adopted to keep the cost of a particular casting within reasonable bounds, while at the same time producing an article that will not suffer in comparison with one made under more favorable circumstances. The gas engine bed plate shown in the accompanying illustrations affords an interesting example of how one such job was handled.

An engine building plant secured an order for two engines considerably larger than any heretofore built. Existing equipment enabled them to handle all the castings with comparative ease. That is all except the bed plates. These castings, 17 feet long by 4 feet wide, weighing 6000 pounds and designed in a special manner to meet the customer's specifications were too long for any cope in the foundry. Two methods suggested themselves. The first involved molding the pattern face down and lifting the interior body of sand on suitable arbors suspended from two copes butted

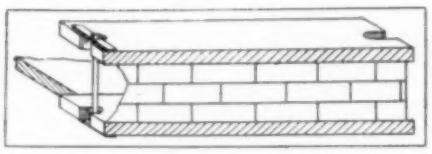


FIG. 1—DETAIL OF BINDER

end to end. The principal objection to this method, other than the slanting parting necessary between the ends of the two copes and the risk attached to closing the mold, lay in the probability of the casting warping. On account of the pressure developed by the high pouring head, the bottom plated portion of the casting would be strained beyond its proper thickness and since the upper and lighter parts of the frame would cool and contract first, in all probability the face of the casting would be warped an inch or more out of a straight line in a distance of 17 feet.

Alternative Method

The second method, the one that finally was adopted, probably involved a little more work in the foundry, but it insured a clean casting and one that was perfectly straight when it left the mold. A plain but rigid skeleton pattern was employed, the mold was made in the position shown in several of the illustrations. The body of sand, forming the interior, was not disturbed, but the exterior was *checked-off* on a lifting plate and the top was covered with a loam plate in two parts.

Other factors which influenced the decision in this case, and in other cases of a similar character involving work outside the usual routine, were: Prospect of a repeat order; patternmaking economy; reduction of core making costs; minimum expense for foundry equipment and probable chipping and cleaning costs. The jobbing foundryman finds any or all of these worthy of more than casual consideration, for upon their neglect or observance will depend the loss or profit in a job.

A pit was opened in the foundry floor at a point accessible to the two cranes. This was approximately 25 feet long, 7 feet wide and 4 feet 6 inches deep. Two existing binder gratings, each provided with loops for four binders were bedded down solidly, end to end, on the bottom of the pit. The entire area then was covered with cinders and a 3-inch vent pipe was laid sloping at each of the four corners of the pit. After ramming about 12 inches of sand

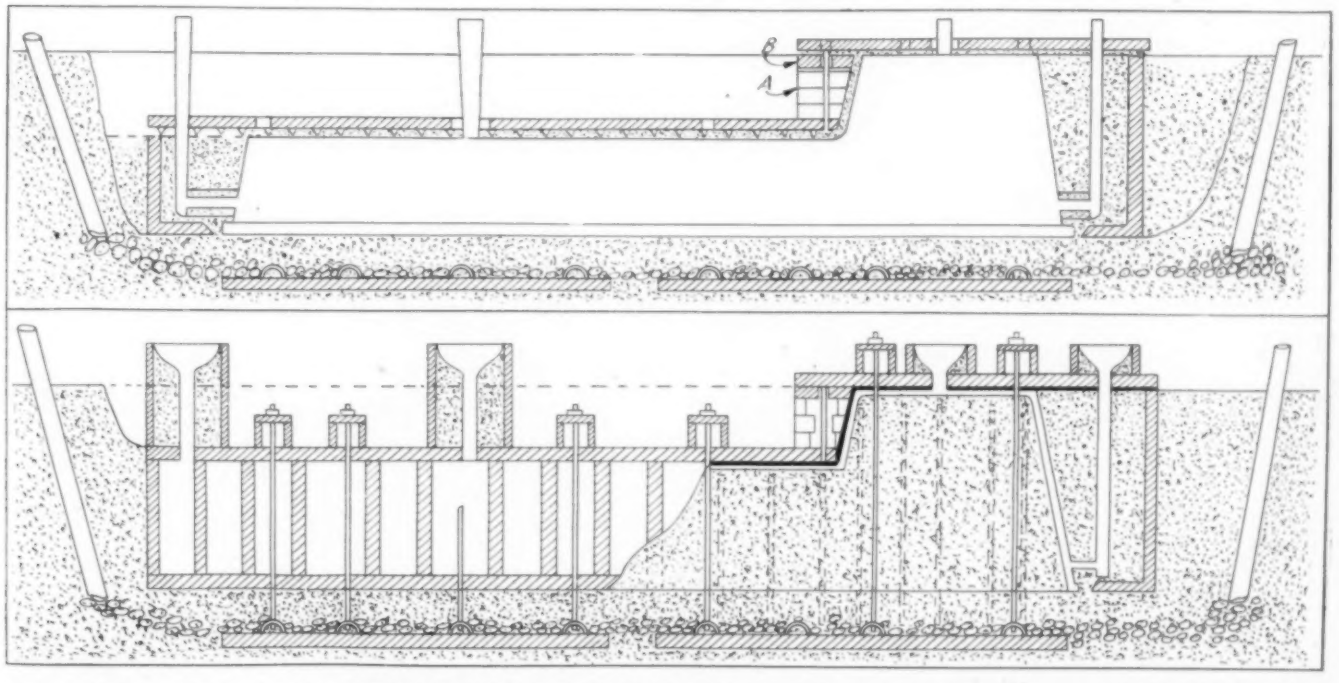


FIG. 2—ABOVE—MOLD AS IT APPEARED BEFORE THE COVERING PLATES WERE REMOVED FIG. 3—BELOW—CROSS SECTION OF MOLD AS IT APPEARED JUST BEFORE IT WAS POURED

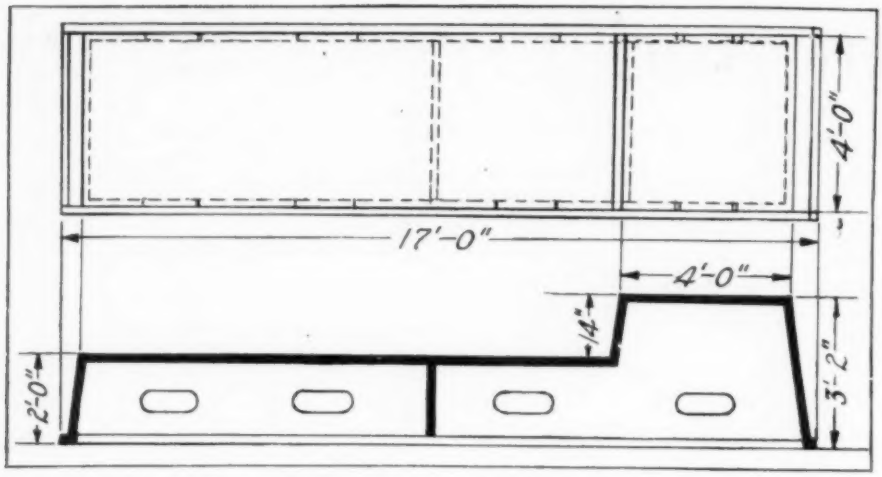


FIG. 4—SECTION AND PLAN VIEW OF BED PLATE PATTERN

over the cinders, a bed was leveled on the bottom of the pit. This was done by sections, one third at a time. The straightedges were moved endways, alternately, until the bed extended from one end of the pit to the other. A line was tried over the entire length to test its accuracy.

The pattern was lowered onto the bed, approximately in the center of the pit and weighted to hold it in place during the earlier stages of preparing the mold. The outside lifting plate, shown in Fig. 6, provided with long prods along the outer edge corresponding in height to the walls of the pattern, was lowered into place and pounded down solidly, after which sand was rammed inside and outside the pattern until the pit was filled level with the pattern.

A gate core was bedded at each of the four corners immediately above the small flange surrounding the base of the pattern. This detail is shown quite clearly in Figs 2 and 3. Square runner sticks were placed upright behind the core gates and the entire gate arrangement was kept inside the prods on the ends of the lifting plates to save time and trouble later when assembling the mold preparatory to pouring the metal.

The body of sand forming the interior of the mold was reinforced by stakes driven into the bed and also by rows of rods laid horizontally about 8 inches apart at every course of sand. The open-top pattern lent itself readily to this procedure. The rods along the sides and ends were laid fairly close to the pattern, but those in the corners were kept back far enough to permit a generous fillet to be cut while finishing the mold.

A parting was made conforming to the countour of the pattern, level with the foundry floor at the high end and level with the working face of the pattern for the greater part of its length. A 1-inch thickness of loam was spread over the face of the pattern and parting and the longer of the two covering plates lowered and pressed into place. A narrow wall built up at the shoulder of the pattern was bound firmly to the long cover plate by a small plate provided with suitable slots at each end. This part of the mold is indicated at *A* and *B* Fig. 2 and more in detail in Fig. 1. The coating of loam spread over the high part of the pattern to receive the short covering plate was extended to embrace the step built up on the end of the long plate. The short plate then was bedded down and the mold appeared as shown in Figs. 2 and 3.

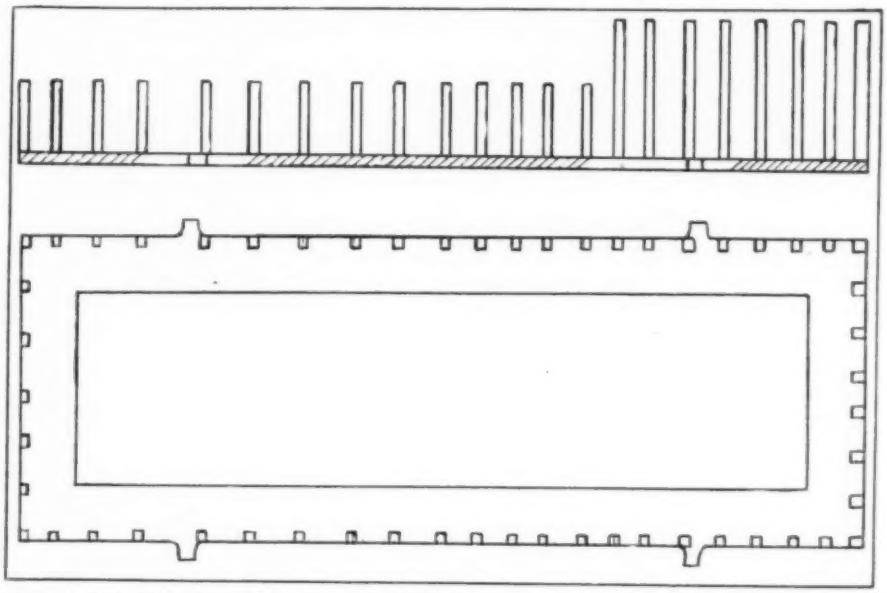


FIG. 6—THE INSIDE EDGE OF THE LIFTING PLATE WAS BEVELED TO PREVENT THE SAND FROM WASHING OR SCABBING

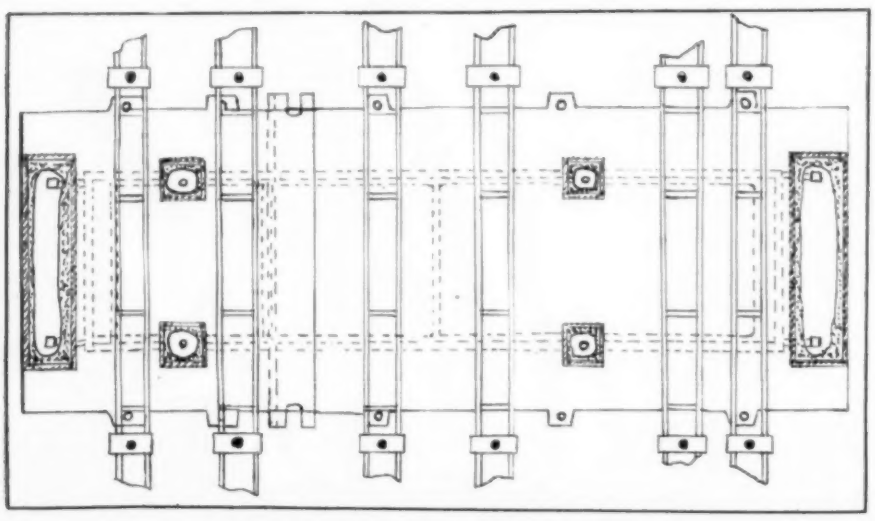


FIG. 5—PLAN VIEW OF ASSEMBLED MOLD

The loam was allowed to stiffen over night before the covering plates were removed. The short cover plate was lifted first on account of the manner in which one end overlapped the shoulder built up on the end of the long plate. The second plate with the attached shoulder then was lifted and after both plates had been rolled over, finished and blacked, they were placed in the oven over night to dry.

The sand filling the space between the prods on the plate and the walls of the pit was dug and then the cheek

part of the mold; suspended from chains on the two cranes, was lifted out, set down on suitable stands finished and blacked. Strikes were employed to cut the required thickness of sand from between the ribs of the skeleton pattern and after the body of sand inside the pattern had been vented and faced, the pattern was removed and the face of the mold was finished and blacked. Cheek and drag were finished simultaneously to avoid occupying valuable shop space any longer than necessary.

The four flat cores designed to form the four hand holes on each side were nailed to the main core and ⅛-inch clearance allowed for the cheek walls to pass in closing the mold. The company's name plate was stamped on each side of the cheek by stencil. On the smaller sizes of engines the practice is to form the name plate in a flat core and ram the core while ramming the cheek of the mold. In addition to carefully finishing, filleting and blacking the mold the corners and the area exposed to the greatest rush of incoming metal, were nailed securely.

After lowering the cheek into place, the open space all around, again was filled with sand which was rammed firmly to withstand the lateral pressure of the mold while filling with iron. The cover plates then were adjusted and wedges placed between the tops of some of the prods and the face of the plate so that all the weight would not come on the sand walls of the cheek. The mold was bound together by eight bolts on each side, attached to the gratings on the bottom and to binder bars on the top as shown in Figs. 5 and 3, illustrating respectively the plan view and section of the finished mold.

Operates Warning Signal if Feed Stops

BY E. J. EDWARDS

CONSIDERABLE trouble with a powdered fuel burner has been caused when the alternating current has been cut off. To obtain a variable speed on the coal feed motor, direct current is employed; but the blower, built for constant speed, runs on alternating current. The volume of air in the pipes is regulated by suitable dampers in the pipe line. When the alternating current was off the blower would stop, but the coal screw would continue feeding and as a result the burner would choke. This would necessitate taking the burner apart, cleaning it and frequently replacing broken parts. The same condition might obtain if the operator carelessly started the coal screw first instead of the blower when starting the burner. The accompanying illustration shows a device recently installed which automatically stops the coal feed screw when the blower stops and at the same time sounds a horn to attract the operator's attention.

The blower unit is started first by the alternating current starter, as the direct current motor cannot be started until after the alternating current motor. When starting the alternating current motor, a solenoid is energized on the alternating current contact panel equipped with two contact fingers. One finger is in the coal feed motor circuit and the other finger is in the signal horn circuit. Energizing the solenoid causes the coal feed circuit to close and the horn circuit to open. When the blower is shut down, the solenoid becomes dead automatically shutting down the coal feed circuit and at the same time closing the signal circuit which immediately attracts the operator's attention. The horn may be shut off by a snap switch until the burner is again started. The warning signal is on a lighting circuit in which a transformer reduces the voltage to approximately 12 volts. The horn is attached in series to the finger on the contact panel. The coal feed is chain connected and is driven by a direct current motor. In the circuit a finger is mounted on the contact panel, automatically operated by the blower circuit.

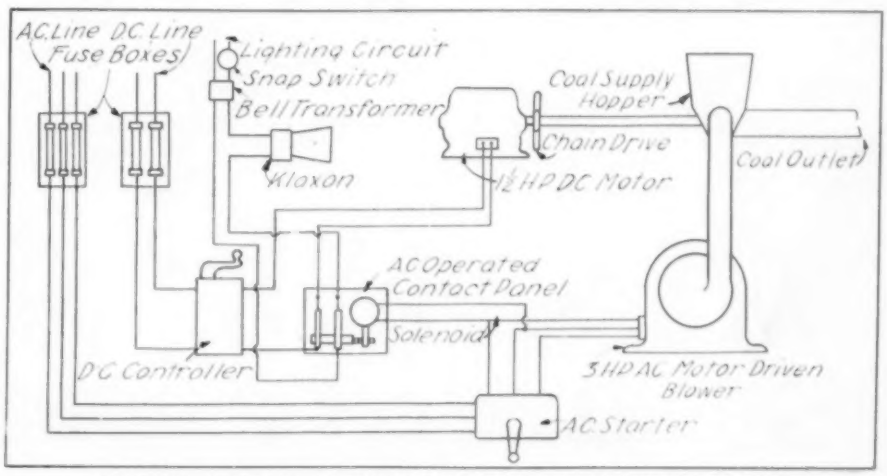
Annealing Prolongs Life of Ingot Molds

By James Thomas

Experience gained by a large steel plant would seem to indicate that the active life of ingot molds can be extended to a considerable degree by annealing them in soaking pits before they are used for the first time Under ordinary operating conditions the molds are subject to extreme expansion and contraction strains. In many instances new molds are placed in service without any preliminary heating of any kind. This treatment intensifies any inherent strains in the casting developed while in process of manufacture. Annealing will relieve these strains and prolong the life of the mold, but the practice in some steel plants of heating the molds with some type of burner is not of much practical use in that the mold is not heated to a sufficient degree. Ingot mold manufacturers stack the molds in a pile immediately after they are shaken out of the flasks and allow them to remain there for about 48 hours. In this manner they are annealed to a certain extent before they are cleaned.

Opens a New Foundry

The Gartland-Haswell Foundry Co., has opened its new foundry at Sidney, O. This plant which is one of 15 gray iron and malleable foundries owned and operated by the same company was completed late in 1920, but was not called into service during the business depression of 1920 and 1921. The officers of the company are: M. F. Gartland, president; Frank X. Gartland, vice president; John C. Haswell, treasurer; W. J. Gruss, sales manager, G. R. Wood, superintendent.



GENERAL LAYOUT SHOWING LOCATION OF WARNING SIGNAL

Graphite Structure Revealed

Microscope Shows Under the Higher Magnifications the Complexity of the Graphite Grains in Cast Iron Indicating that Strength of Gray Iron Is Largely Dependent on Graphite Structure

BY H. E. DILLER

METALLOGRAPHY has been of benefit to the foundry industry in giving metallurgists a clearer idea of the compounded constituents of iron and steel. It has shown the different forms in which carbon exists in steel and has furnished the basis for a deeper study into the effects produced by heat treatment than could be made by mere chemical analysis. Thus the steel treater has made more use of microscopy than the foundryman. However the metallurgist in the steel foundry gradually is availing himself more of the benefits of microscopic study of the structure of the metal with which he works, and the microscope is finding a wider use in the iron foundry. In this field it has the problem of graphite to deal with and is revealing to the student that this element does not exist in cast iron as a pure graphite but the graphite areas are made up of graphite mixed with other constituents of the metal, such as pearlite, sulphides, etc. Evolution of hydrogen sulphide gas from graphite in a sample of gray iron treated with dilute phosphoric acid is shown by J. W. Bolton in THE FOUNDRY, June 1, 1922, page 440.

The form of the graphite also may be seen clearly under the microscope. A striking illustration of this is shown in Fig. 1 which consists of five micrographs made of a piece of gray iron by George H. Lane, York Mfg. Co., York, Pa. Each micrograph was made of a section immediately joining the section of which the previous micrograph was made. In this way a straight line of the metal is shown under magnification. These micrographs were made under a magnification of 100 so the surface of metal represented by the total length of 15 inches of micrographs is really only 0.15 inches, or only slightly over ⅛ inch long.

In this particular specimen a marked change in grain size in the fracture could be noted with the naked eye. This change appeared to be abrupt, showing a line of demarcation between the coarse and the fine grained structure. However, under the microscope a gradual change is shown, the small particles of dark graphite spots becoming less numerous and the flakes getting larger as the fine structure shades into the coarse.

As may be noted, through the entire length of the illustration, some heavy spots of graphite are shown, even in the finer section. In the section with the coarser grain the graphite is extended into long narrow flakes. At 100 magnifications unetched, as shown in Fig. 1 all the graphite appears to be of the same character except as for shape. Etching served to bring out the structure of the metal more clearly as indicated by Fig. 2 which is a micrograph of one of the larger areas of graphite magni-

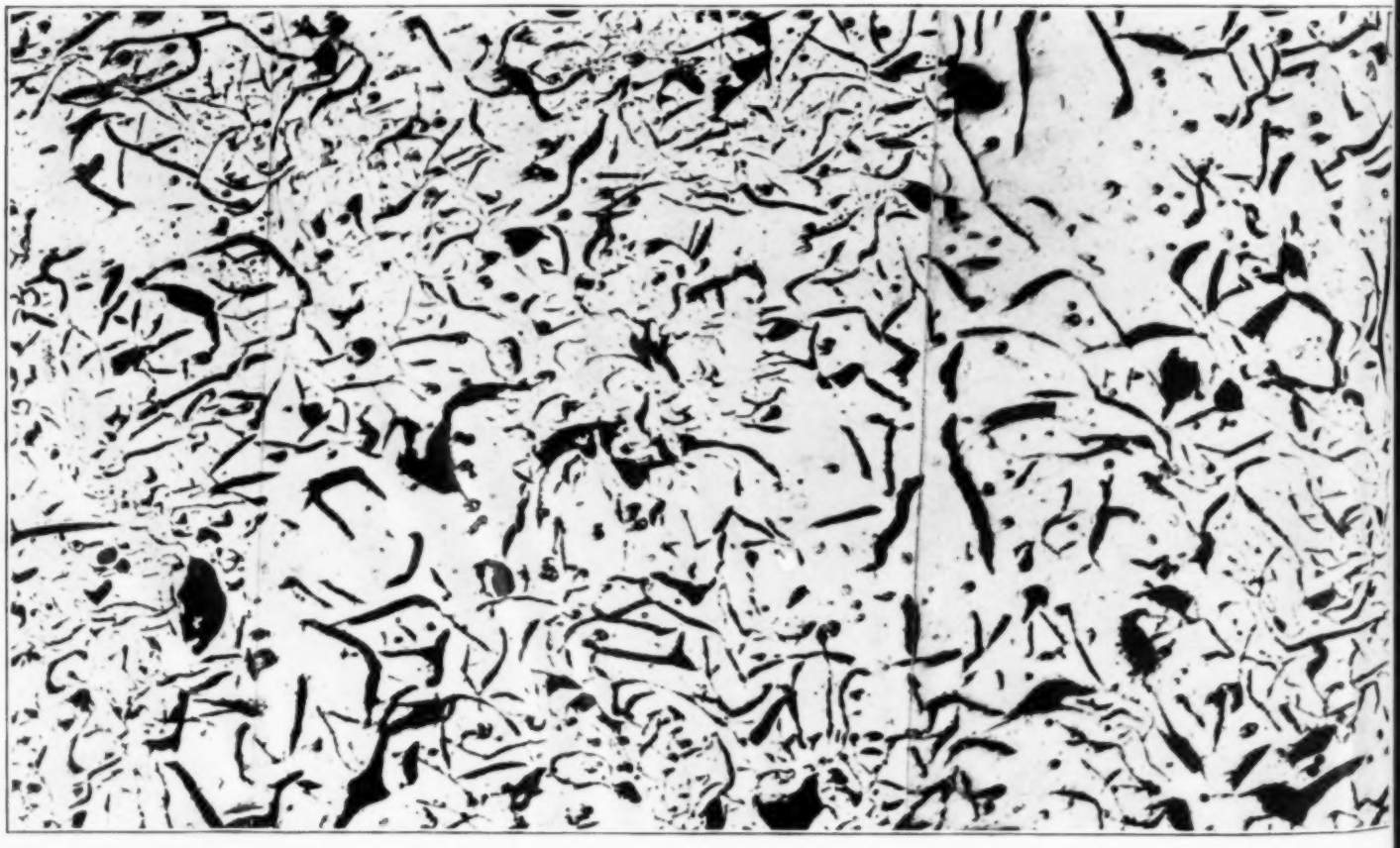


FIG. 1—IN A PIECE OF CAST IRON WHICH HAD A PRONOUNCED CHANGE IN GRAIN SIZE THAT APPEARED AS A SHARP LINE SPECIMEN—THE 15 INCHES OF ILLUSTRATION MADE FROM FIVE PHOTOMICRO

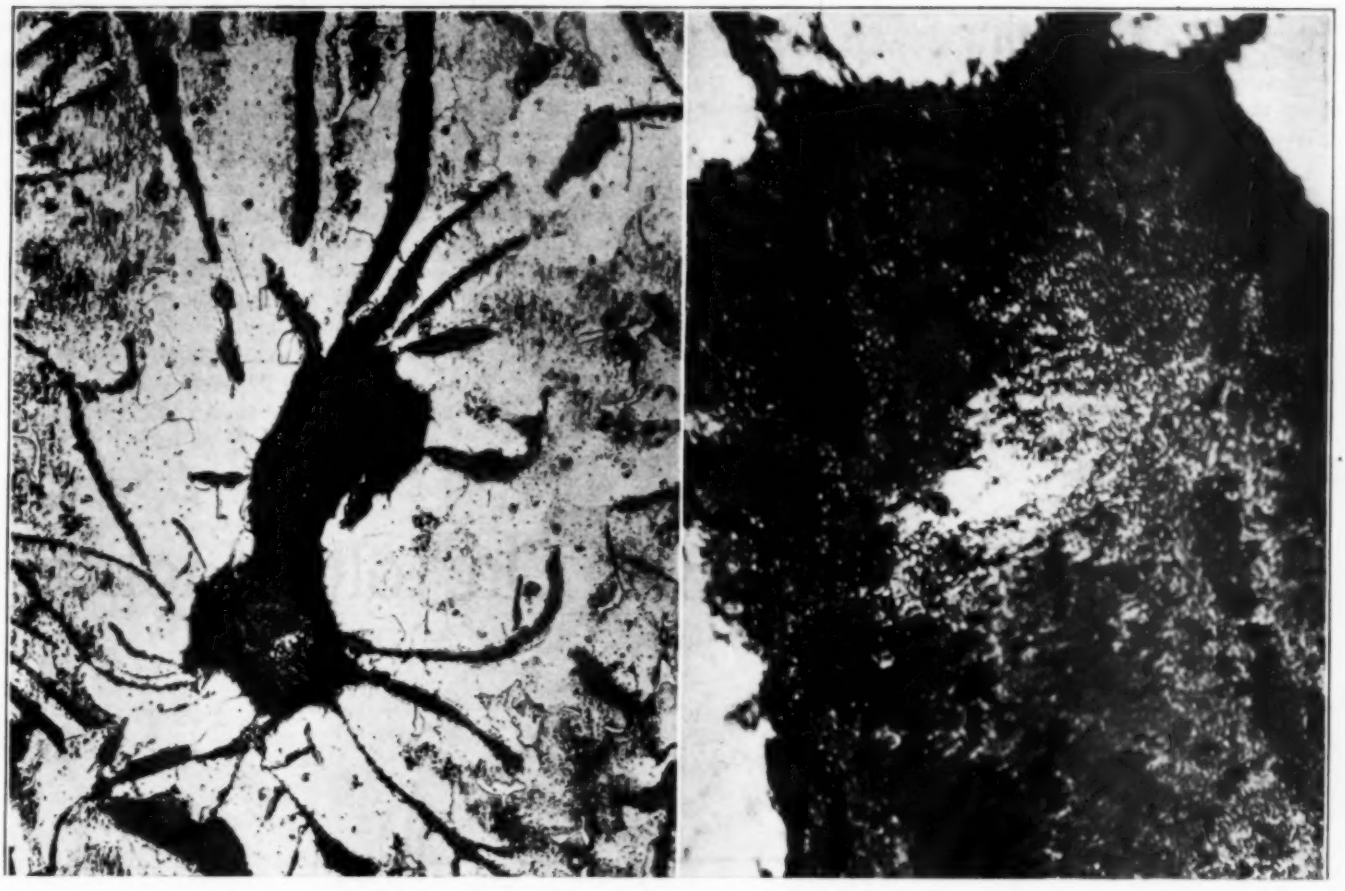
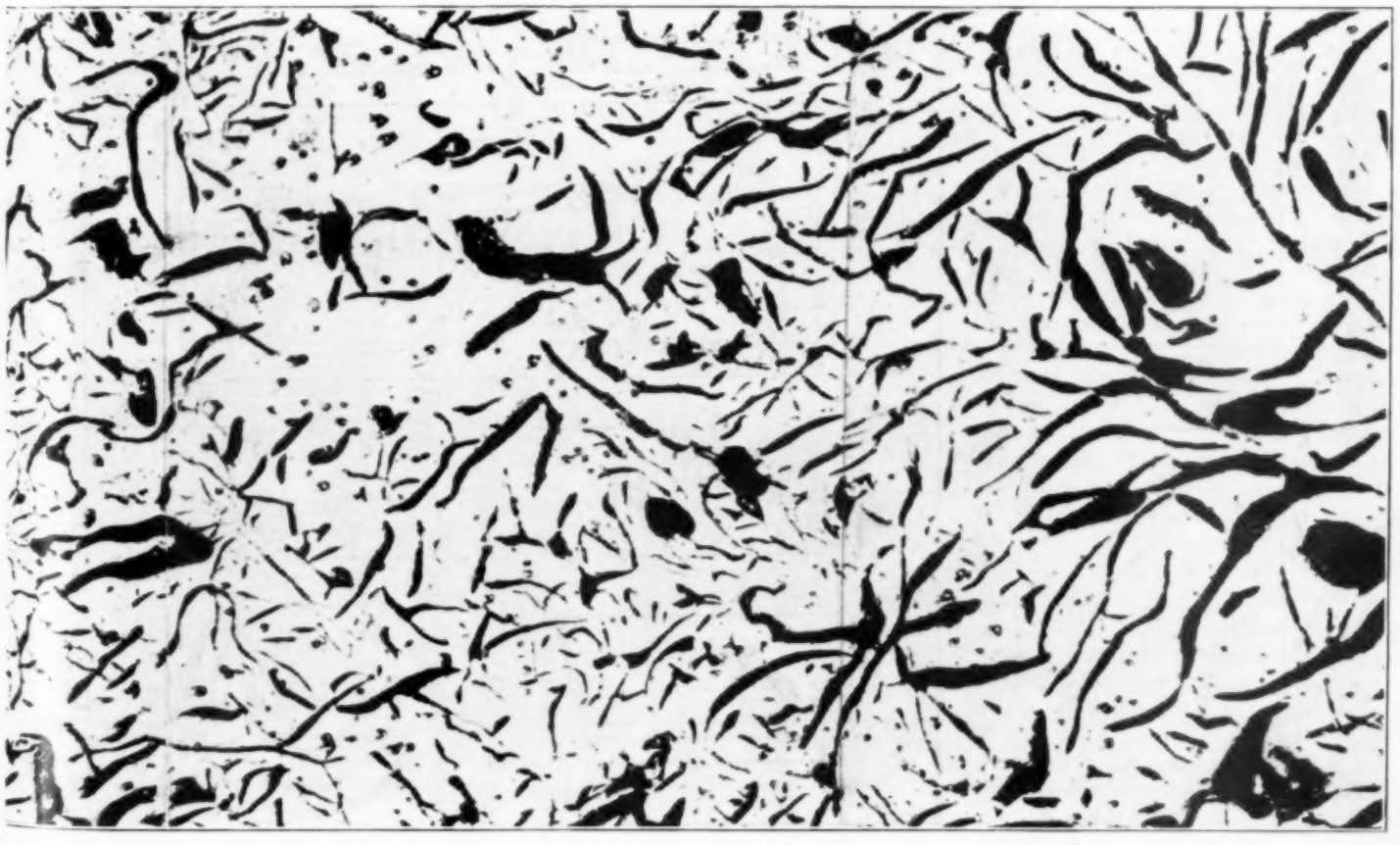


FIG. 2—ETCHED WITH PICRIC ACID AND MAGNIFIED 100 DIAMETERS. THE LARGER AREAS OF GRAPHITE AS WELL AS THE LONG FLAKES SHOW LIGHT SPOTS. FIG. 3—LARGE AREA SHOWN IN FIG. 2 ETCHED WITH PICRIC ACID AND MAGNIFIED 650 DIAMETERS



IN THE CASTING. THE MICROSCOPE UNDER 100 MAGNIFICATIONS REVEALS A MORE GRADUAL CHANGE IN THE UNETCHED GRAINS REPRESENTS A LENGTH IN THE CASTING OF ONLY 0.15 OR ABOUT 1/8-INCH

fied 100 diameters. In this illustration a portion of the largest area of graphite shows a light color and some of the long flakes show a white line along their axes.

This same spot of graphite magnified 650 diameters and etched with picric acid is shown in Fig. 3. This illustration would seem to indicate that the graphite spot is not entirely graphite but contains some iron in the form of ferrite and possibly pearlite. At least it gives an inkling of why gray iron can be so strong even though honeycombed with graphite, which would be a weak substance if pure. Emphasis is laid on this point when it is remembered that graphite is much lighter than iron and a casting which would contain 2.80 per cent graphite by weight would be made up of approximately 9 per cent by volume of that weak element. The volume of graphite shown in the micrograph, Fig. 1, clearly indicates the extent to which the continuety of the metal is broken up, and if these dark spots were entirely of the soft graphite it would seem that the metal would be much weaker than it is. Further emphasis is laid on this point by the fact that a sample cut from the average close grained pig iron made in a hot-blast furnace will have a tensile strength of considerably under 20,000 pounds per square inch, while a pig iron of approximately the same analysis made in a cold-blast furnace will have a tensile strength of approximately twice this amount. Of course it is not conclusively proven that the difference in strength is due to the composition of the graphite grains, but in the absence of any other rational cause for the increase in strength it may be attributed to the structure and composition of the graphite grain. This also may explain the increase in strength acquired by the addition of small amounts of steel to the cupola in making a cast iron which has such marked characteristics that it has been considered a distinct product and has been called semisteel for want of a better word to describe it.

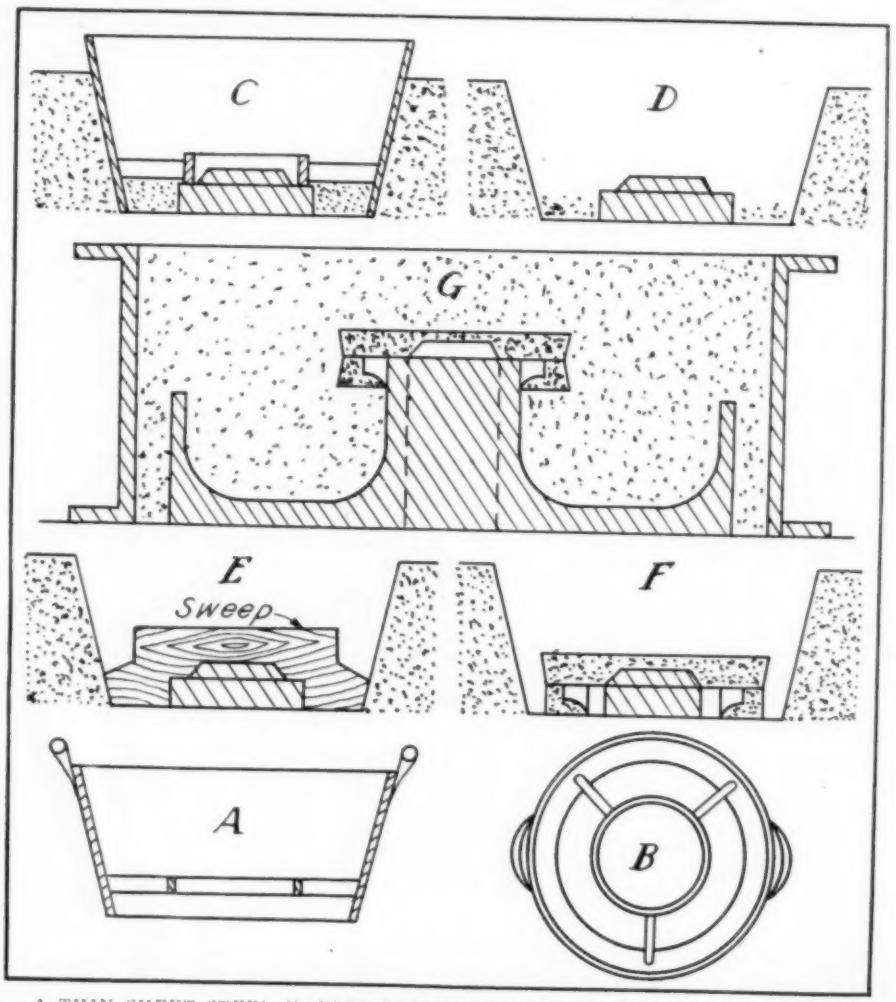
Making Flanged Hub On Jolt Machine

BY GORDON WHITE

A PATTERN with a loose flange ring around the bottom of the hub cannot be employed when the mold is to be bumped on a jarring machine, because the sand will settle away from the under side of the flange. The usual method is to prepare a ring core in two parts and slip it over the end of the hub after the drag has been jolted and after a narrow seat has been swept around the hub to receive it. On the job shown in the accompanying illustration, the time consumed in digging down and forming a core seat around the hub became a serious factor and interfered with production to such an extent as to nullify the advantage of using a jolting machine. The problem was solved by designing a hopper made of 1/16-inch steel having an opening at the bottom about 2 inches larger than the flange core and with an opening at the top 4 inches larger in diameter than the bottom. A small ring designed to fit closely around the center core print and rest on the hub is attached by three brackets riveted in place to the inside of the hopper. The bottom edge of the hopper extends to the point where the sand is to be swept off to form a seat for the flange core.

After the drag is bumped the hopper is lifted out by the two handles provided for that purpose. It readily is apparent that on account of its shape the hopper comes away readily and it also is apparent for the same reason that the body of sand within the hopper will come with it. The task of sweeping a seat and setting the flange core is simplified to a considerable extent by the use of this device.

In the accompanying illustration *A* is a cross section of the hopper, *B* is a plan view of same, *C* shows the hopper in place with the drag rammed full of sand, *D* is the mold after the hopper has been lifted, *E* is the sweep in operation, *F* is a view of the mold with the flange core in place and *G* is the mold complete.



A THIN SHEET STEEL HOPPER LIFTED OUT AFTER THE DRAG IS JOLTED FORMS A SEAT FOR THE FLANGE CORE

Bricks for Malleable Furnaces

Load and Softening Tests Are Not Reliable Criterions of the Behavior of Brick in Service, Whereas the Spalling Test Bears a Close Relation to the Service Test

BY H. G. SCHURECHT

MANUFACTURERS of brick for use in malleable iron furnace bungs have experienced considerable trouble due to lack of knowledge of the constitution and properties such brick should possess. Brick made of clays passing the customary load and softening-point tests often fail when used in malleable iron furnace bungs. For example, in one case a brick standing a high load test failed under three heats in practice, whereas, another brick failing in the load test stood an average service test of 17.5 heats. Actual service tests consume too much time, whereas laboratory tests can be made quickly. Therefore a thorough study of the relations existing between laboratory tests of bung brick and their ability to stand up in practice was undertaken by the ceramic station of the United States bureau of mines. Although the investigation was limited to brick used in malleable iron furnaces, the results may be applied to refractories for other furnaces requiring similar service.

In actual practice, complete 7-foot arches, shown in Fig. 1, containing 40 bricks, were tested. The number of heats withstood by the different arches was used as a method of comparing the serviceability of the different varieties of brick forming the arches. All the bungs tested were placed in a definite position over the firebox where they received the same and the severest heat treatment of the furnace. After each heat the bungs were removed from the furnace during the recharging.

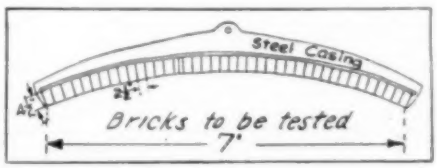


FIG. 1—MALLEABLE FURNACE BUNG

This chills the brick and tends to cause spalling. The tests were made in a 40-ton malleable iron furnace operated by the Ohio Malleable Iron Co., Columbus, O. Three or more bungs of each brand of brick were tested.

Laboratory Tests

The following factors were investigated in laboratory tests made on each brand of brick:

1. Per cent spalling loss.
2. Per cent deformation under load.
3. Density.
4. Per cent apparent porosity.
5. Softening temperature.
6. Chemical analyses.
7. Permeability of gases.

For the spalling test four or more brick of each brand were selected, those showing cracks and flaws being discarded. The brick were dried at 110 degrees Cent. for five hours or more, and weighed.

The test furnace was heated to 1350 degrees Cent., and held at this temperature for one hour. The bricks then were placed in pairs in 4⅝ x 5¼-inch openings left in the doorway of the furnace, with the 2½ x 4½-inch ends exposed to the fire, and heated one hour before quenching.

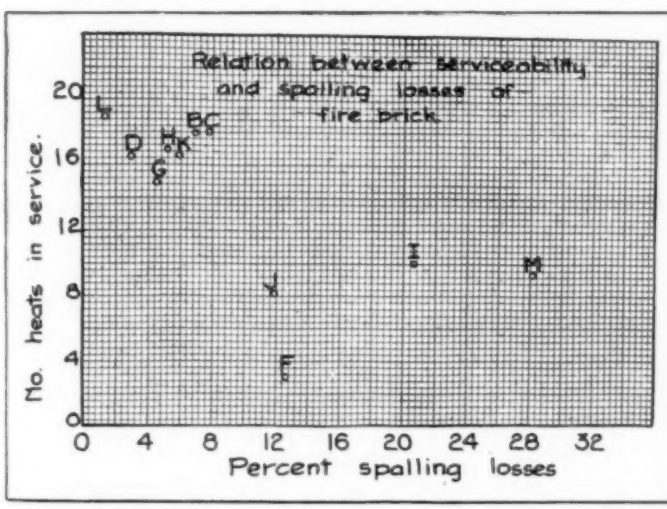
Two bricks at a time were removed and plunged into running water (at about 20 degrees Cent.) to a depth of 4 inches and held three minutes, after which they were removed and allowed to dry three minutes in air. As soon as two bricks were removed from one of the openings they were replaced by two others, thus preventing cooling of the furnace.

Each brick was heated and quenched 10 times. After the tenth quenching the brick were dried at 110 degrees Cent., for five hours and all particles easily removable by the fingers were broken off. The brick were then weighed and the percentage loss in weight calculated on the basis of the original weight.

The resistance of fire brick under load was determined by applying a load of 25 pounds per square inch to the bricks and heating them to 1350 degrees Cent., and holding the furnace at this temperature for 1½ hours. The per cent deformation was noted and used as a measure of the resistance to load at furnace temperature; see *Journal*, American Ceramic society, Vol. II., pp. 602-7 (1921).

The softening temperatures were determined by comparison with standard Orton cones. The apparent densities and porosi-

From a paper presented before the convention of the American Foundrymen's association at Rochester, N. Y., June 5-9, 1922. The author is connected with the ceramic experiment station, United States bureau of mines, Columbus, O.



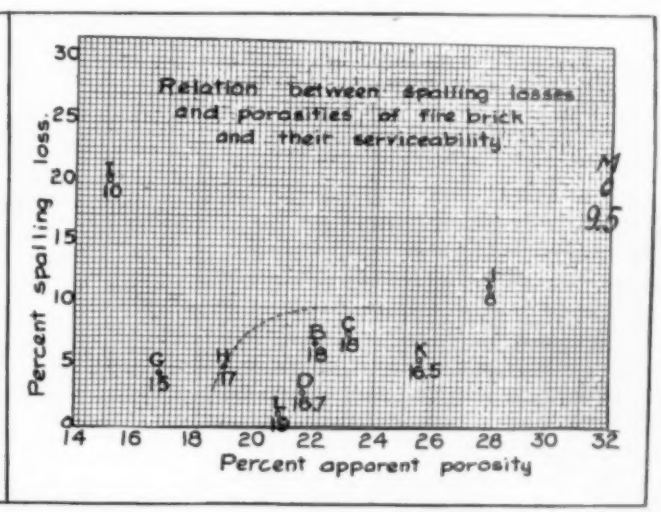


FIG. 2—RELATION BETWEEN SERVICEABILITY AND SPALLING LOSSES OF FIRE BRICK FIG. 3—RELATION BETWEEN SPALLING LOSSES AND POROSITIES OF FIRE BRICK AND THEIR SERVICEABILITY

Table I

Malleable Furnace Bung Brick

	No. heats in service	Per cent spalling loss	Per cent deformation under load	Softening point of brick cones	Softening point of bond clay cones	Density	Per cent apparent porosity	Permeability of gases, cc. per sec. per sq. cm.
L	19	1.30	0.90	..	..	2.282	20.87	0.0407
B	18	6.94	4.85	30–32	30–31	2.044	22.04	0.2070
C	18	7.92	1.95	32	32	2.025	23.15	.....
A	17.5	2.56	6.35	..	..	1.985	24.78	.....
H	17	5.18	0.40	32	30	2.043	19.03	0.1733
D	16.7	2.99	2.05	32	31	2.113	21.67	.....
K	16.5	5.80	....	..	..	1.958	25.51	.....
G	15	4.36	6.90	32	30	2.188	16.80	.....
E	15	5.31	7.00	27	26	1.976	25.34	0.0630
I	10	20.36	1.10	32	30	2.123	15.11	0.1828
M	9.5	28.20	0.65	..	..	1.910	24.92	0.1988
J	8	11.94	....	..	..	1.888	27.86	.....
F	3	12.51	2.80	..	..	1.910	20.56	0.1959
Carborundum	24+	½	....	..	..	.....	.....	.....

ties were determined by the water and oil immersion methods and calculated as follows:

$$D = \frac{W_a}{V_b}$$

D = Density.

W_a = dry weight.

V_b = bulk volume (true clay volume plus pores).

$$P_a = \frac{W_s - W_a}{V_b} \times 100.$$

P_a = per cent apparent porosity.

W_s = saturated weight (saturated in water).

The permeability of gases through the brick was measured by forcing air at a low pressure through the 2½-inch thickness of the brick.

Results of Tests

The results of this investigation are shown in part in Tables I and II and Figs. 2, 3, 4, 5, 6 and 7. The results indicate that the load test is no criterion of serviceability in malleable iron furnace bungs. For example, bricks *A* and *B* behaved poorly in the load test but stood up well under service, while bricks *I* and *M* stood up well in the load test but behaved poorly in service. Obviously the brick should be strong enough to support the arch at high temperatures, but any extra strength above a safe limit is unnecessary. Brick deforming as much as 6.35 per cent under the load test in some instances gave excellent service in the malleable iron furnace bungs.

The softening point of malleable furnace bung brick should be sufficiently high to prevent the brick from melting but it is not necessary for them to stand a high softening point test (cone 31 or above). Brick having a softening point of cone 30 often give as good service as those softening at cones 31 to 33.

The closest relation of the tests made appears to be between the per cent spalling loss and serviceability. The brick showing the smallest spalling loss, as indicated in Fig. 2, stand up best in practice. When the spalling loss was above 8 per cent the number of heats which the corresponding bricks withstood in practice was below 15 in each case.

There appears to be a relation between the porosities of fire brick, their resistance to spalling and their serviceability (as indicated in Fig. 3). If a brick is too dense it cracks, due to differences in expansion of different portions. A more porous brick is less brittle and yields without cracking to these differences in expansion. When a brick is too porous, it also spalls readily. This may be due to the fact that porous bricks lack mechanical strength and have a higher coefficient of expansion as compared with the more vitreous bricks, which was shown in Ricke's work, *Keram. Rundschau.* Vol. XIV, pp. 143-145 (1914).

Corrosive gases and slags also penetrate a porous brick more readily than a denser one, which would result in producing a more brittle brick and hence one which is more susceptible to spalling. In examining the density and porosity data in Table I and Figs. 3 and 6, it appears that the dense, nonporous bricks give better

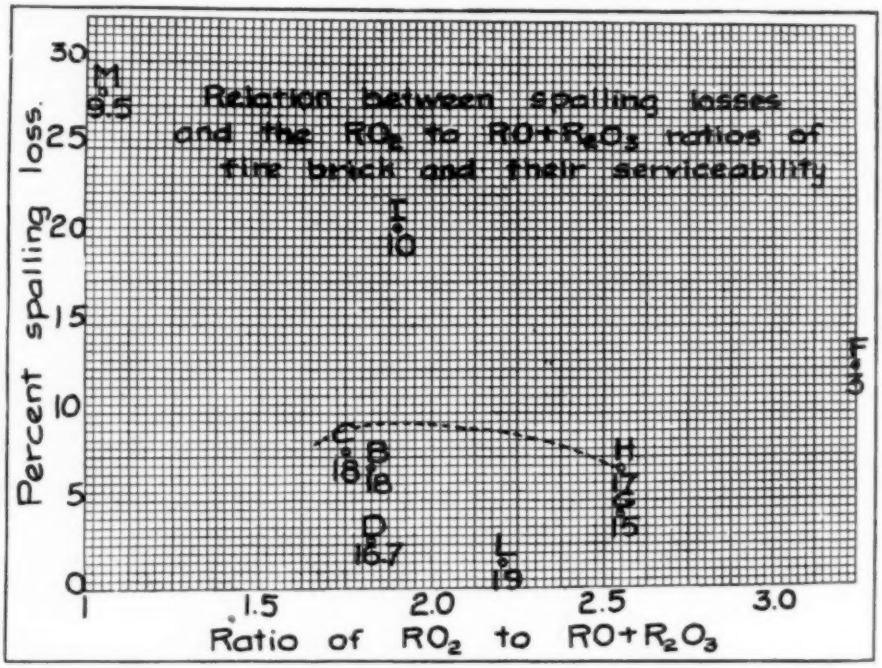


FIG. 4—RELATION BETWEEN SPALLING LOSSES AND THE RO_2 TO $RO_2 + R_2O_3$ RATIOS OF FIRE BRICK AND THEIR SERVICEABILITY

Table II

Chemical Analyses of Bung Brick

	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	Alkalies	RO_2 / R_2O_3	RO_2 / $RO+R_2O_3$	No. heats in malleable furnace bungs
L	54.73	39.23	2.10	0.05	0.07	1.10	2.30	2.21	19
B	52.20	43.42	2.18	0.40	0.40	1.47	1.98	1.83	18
C	51.04	41.04	2.17	0.65	....	4.48	2.05	1.75	18
A	52.93	42.69	1.98	0.53	0.38	1.55	2.04	1.89	17.5
H	58.36	28.76	8.20	....	0.30	3.02	2.93	2.57	17
D	52.60	43.22	2.00	0.40	0.30	1.09	2.01	1.84	16.7
K	54.65	41.36	2.02	0.48	0.29	1.12	2.18	2.03	16.5
G	58.36	28.76	8.20	....	0.30	3.02	2.93	2.57	15
E	52.16	43.71	1.98	0.41	0.30	1.68	1.96	1.82	15
I	53.75	41.50	2.08	0.39	1.75	....	2.14	1.91	10
M	38.40	56.75	2.95	trace	1.10	0.85	1.11	1.04	9.5
J	.....	.....	.....	.....	.....	.....	.....	.....	8
F	66.22	29.83	1.12	0.27	0.29	1.24	3.69	3.24	3
Carborundum	.....	.....	.....	.....	.....	.....	.....	.....	24+

service than the more porous ones, provided the porosity is not too low, in which case the spalling tendency is increased. The brick giving best service had porosities between 15 and 28 per cent, and densities between 1.9 and 2.3. The brick whose porosities and densities were outside of this field gave comparatively poor service.

Chemical Analysis

In examining the chemical analyses in Table II and Fig. 4, it is evident that the ratio of RO_2 to $RO + R_2O_3$ of the best brick lies between 1.5 and 2.6. If the RO_2 (i.e. SiO_2) content is too high, too much free or uncombined silica is present, which increases spalling during heating and cooling, due to the volume changes during the transition of SiO_2 into its various forms at different temperatures. SiO_2 is also more vigorously attacked by the basic slags and gases than Al_2O_3.

Spalling tests were made on a number of different refractories to determine whether some other refractory was more resistant to spalling than fire clay brick. The results follow:

Type of refractory	*Per cent spalling loss*
Fireclay brick	0.63-49.5
Carborundum brick	0
Magnesite brick	Lost over 90 per cent after second quenching.
Silica brick	Lost over 50 per cent. after second quenching

It is obvious that carborundum brick are much more resistant to spalling than the other refractories tested. Therefore, several bungs of carborundum brick were tested in malleable iron furnace bungs. One of the bungs stood up well after 24 heats, after which it was removed because of its high heat conductivity. This service is much higher than that of the fire clay brick tested. The second bung, however, broke the steel casing due largely to the greater weight of the carborundum bricks as compared with fire clay brick. The high heat conductivity of carborundum brick caused the outer surface of the brick to become red, thus allowing considerable heat loss.

By designing special bung casings much stronger than those used, and by using an insulator between the iron casing and the brick to prevent heat losses, carborundum brick may prove to be an excellent refractory for malleable iron furnace bungs because of their great resistance to spalling, and longer services. However, carborundum brick are much more expensive than fire clay brick. It was found that a nonspalling brick gave the best service. A dense nonporous brick gave better results than a more porous brick, provided it was not so dense as to be brittle and thus increase the spalling tendency.

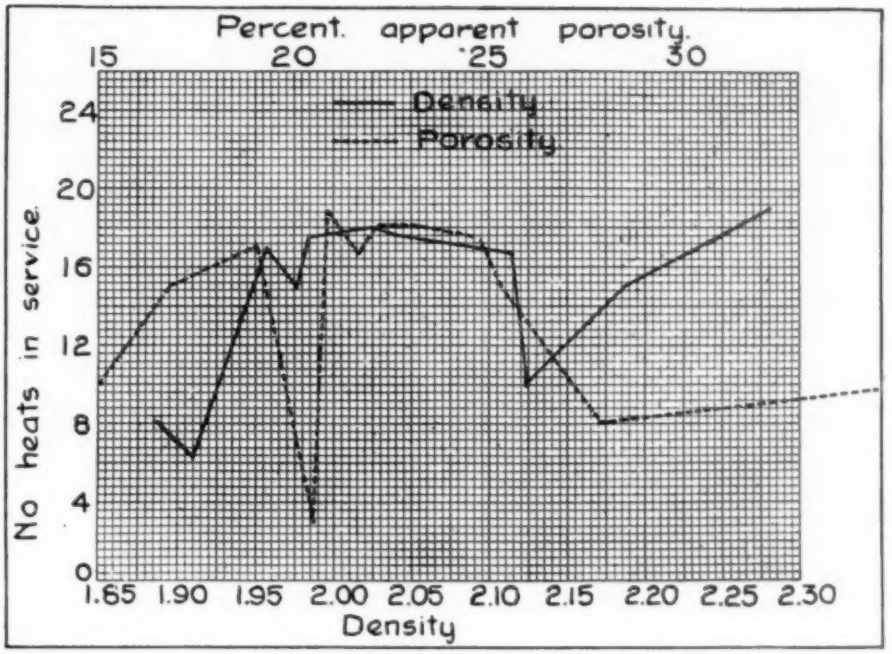


FIG. 6—DENSITY OF FIRE BRICK COMPARED WITH POROSITY

Density and Porosity

The above properties are governed by the selection of the proper clays, the size of grain and the proportioning of the nonplastic to the plastic ingredients, the fineness of grain of the bond clay, the manner of molding, and the temperature of firing. The density and porosity of fire brick can be controlled by the proper selection of clays, and proper firing. Some clays are porous when fired at high temperatures, while others are vitreous. By proper blending of these two types of fire clays, a mixture may be obtained giving any desired porosity. The method of molding also affects the density and porosity of fire brick, as is shown below. The following brick were made with 30 bond clay and 70 grog, *Verlin deutschen Fabriken feuerfeste Produckte* (1914).

Method of molding	Per cent shrinkage	Per cent absorption	Compression strength Kg/cm2
Soft mud	5.0	10.7	87
Soft mud and repress	4.9	9.6	88
Tamped brick	4.8	8.9	103
Dry press	5.1	12.7	50

These results show that a mixture with less water than soft mud consistency and with more water than dry press consistency produces the densest brick, providing sufficient pressure is used in molding.

The size of grain and proportioning of flint clay has a marked effect on the

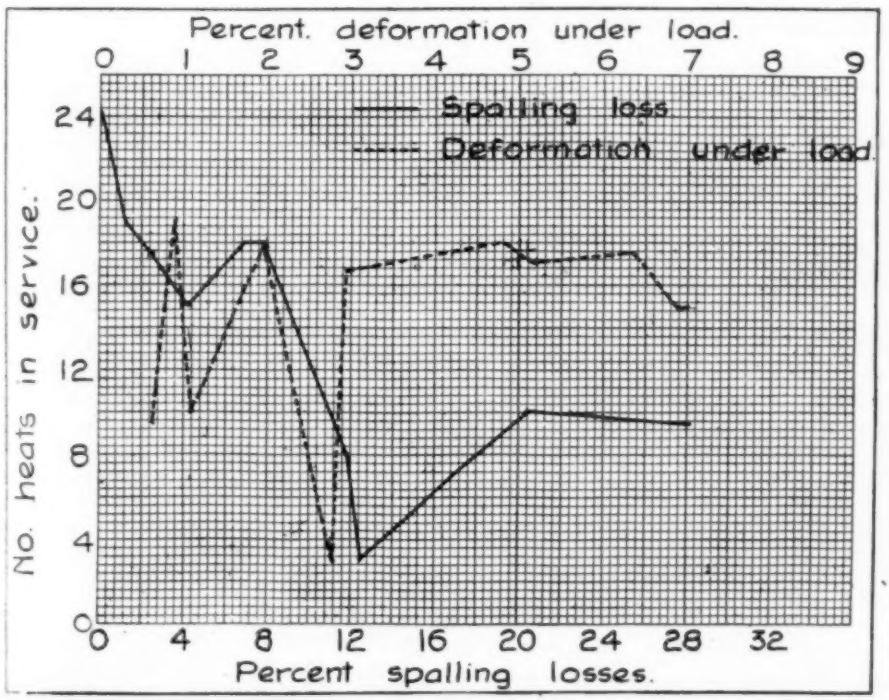


FIG. 5—SPALLING LOSSES COMPARED WITH DEFORMATION UNDER LOAD

spalling tendency. Brick containing a high percentage of coarse grog are more resistant to spalling than those containing fine grained grog. A series of tests in which 1 x 1 x 8-inch bars were heated to 600 degrees Cent. and quenched in water until they broke were conducted by Kirkpatrick on bars containing 50 per cent bond clay and 50 per cent grog. The average results obtained with the different series follow and show that using coarse grog instead of fine increases the resistance of fire brick to spalling, *Journal*, American Ceramic society, Vol. XIX, p. 287 (1917).

Size of grog in mixture	No. of quenchings before specimens broke due to spalling
4-20 mesh	11.1
8-20 mesh	9.3
12-80 mesh	7.5
20-dust	4.7

Increasing the percentage of flint clay and reducing the percentage of bond clay increases the resistance of fire brick to spalling within certain limits as was shown by Howe, *Journal* American Ceramic society, Vol. IV, p. 119 (1921).

The size of grain of the bond clay also affects the spalling tendency of fire brick. For example, it is shown in Fig. 7 that fire clay screened through a 20-mesh sieve is much more resistant to spalling than the same clay ground fine enough to pass a 150-mesh sieve.

Different firing temperatures have a marked effect on the properties of fire brick. For example, it was found that when clays of the fire clay type are fired to cone 8, they are stronger than when fired to cone 6 or 10, even when the porosity and shrinkage data showed the bodies to be over or under fired at this temperature. See *Journal* American Ceramic society, Vol. IV, pp. 366-74 (1921). Investigations on the effects of different firing temperatures on the spalling tendency of fire clays and fire brick show that the firing temperature has an important effect on the spalling of fire brick. Fire clay bars, 1 x 1 x 8-inch, previously fired to cones 6, 8 and 10, were heated to 600 degrees Cent. and plunged into water five times, after which their strength was measured. The strengths of those bars which had been fired to cone 8 were higher after the quenching treatments than those fired to cone 10, indicated in Fig. 7, and in some cases they were stronger than those fired to cone 6. See United States bureau of mines Technical Paper 233, 26 pp. (1920), and *Journal* American Ceramic society, Vol. IV, p. 40 (1921).

Summary

Therefore it appears that by firing to cone 8 a product is obtained which is more resistant to spalling than when fired to cone 10, and in some cases they are more resistant to spalling than those fired to a lower temperature. This may be due to the presence of sillimanite and free silica in the fire brick, which are formed at high temperatures.

The work on malleable iron furnace bung brick which has been done up to the present time has not been extensive enough to draw definite conclusions. The writer, however, offers the following summary which applies only insofar as the work has progressed:

Fire brick for malleable iron furnace bungs should be strong enough to support the arch at high temperatures, but it is not necessary that the bricks should stand as high a load test and fusion test as are required for No. 1 fire brick. Fire brick which may deform as much as 6.35 per cent in the load test may be serviceable as bung brick in malleable iron furnaces.

Although brick which pass high load and softening point tests often give good service in practice, many which pass these tests fail.

The spalling test bears the closest relation to the service test. When the spalling loss was above 8 per cent, the number of heats which the corresponding brick withstood in practice was below 15. In general, brick showing a spalling loss below 8 per cent stood 15 or more heats in practice.

The brick giving best service had porosities between 15 and 28 per cent and densities between 1.9 and 2.3.

The RO_2 to $RO + R_2O_3$ ratios of the best brick were between 1.5 and 2.6.

Carborundum brick withstood more heats than any fire clay brick tested, but are objectionable due to their high heat conductivity and greater weight. These objections, however, can be overcome by using heat insulation and stronger casings.

In the manufacture of malleable iron furnace bung brick, their properties may be governed by the selection of the proper clays, the size of grain and the proportioning of the nonplastic and plastic ingredients, the fineness of grain of the bond clay, the manner of molding, and the temperature of firing.

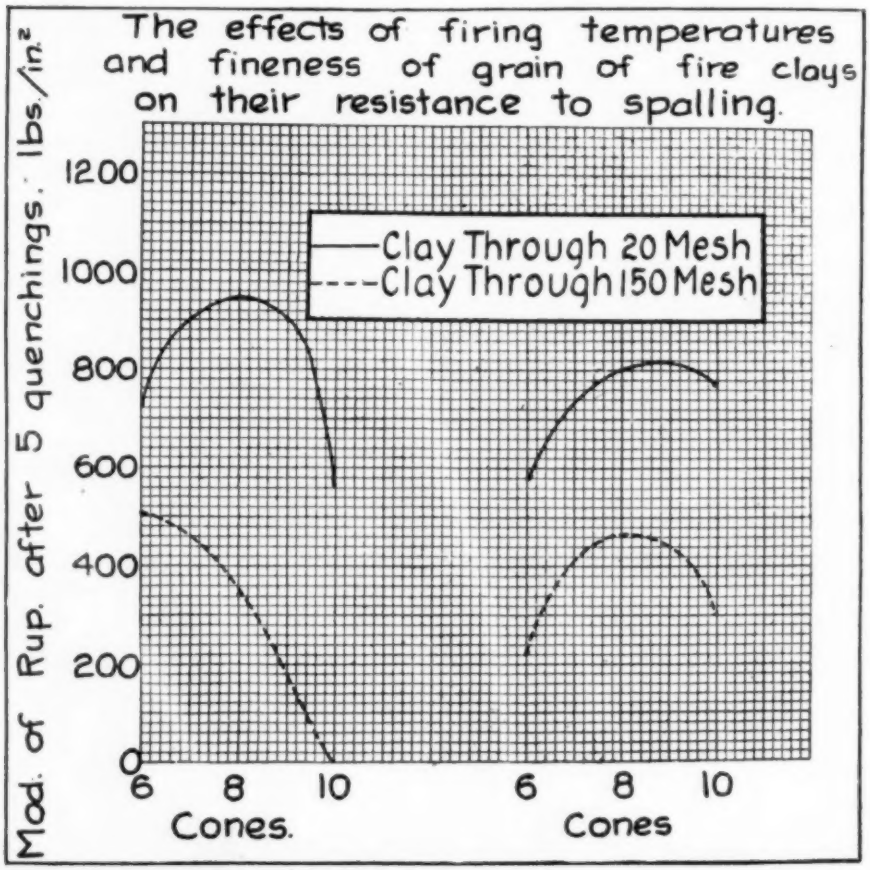


FIG. 7—THE EFFECTS OF FIRING TEMPERATURES AND FINENESS OF GRAIN OF FIRE CLAYS AND THEIR RESISTANCE TO SPALLING

Builds Canadian Plant

The Ohio Brass Co. has purchased 16 acres at Niagara Falls, Canada, and is erecting a factory there with a view to extending its Canadian business.

The company is one of the largest American producers of electrical supplies and equipment for the transmission of electric current from central power stations. As such, it is pointed out, there is a big field for the company's product in Canada, which is one of the leaders in the world in the development of hydroelectric power and transmission lines.

The company has, it is stated abundant capital for the expansion.

Making Red Brass Castings

Metal for Stick Brass and Methods of Molding Are Discussed—Two to Four Castings in a Mold Depending on the Gating and Whether They Are Molded Horizontally or Vertically

BY CHARLES VICKERS

THE term *stick brass* is applied to straight, cylindrical castings varying in diameter from ½ inch to 6 inches and upwards, and usually 12 inches in length. The name fittingly describes these castings as they are simply sticks of brass, sometimes hexagonal, but more frequently circular. However, the shape makes no difference to the construction of the mold; the methods herein described being equally applicable to either cross section.

These castings are seldom used in their entirety, but are cut up to make small parts, such as bushings; the hexagonal sticks being convenient for machining nuts. Many brassfounders specialize both in the solid sticks and cored sticks, or bushings, and keep a considerable weight of metal stocked in these shapes.

No standard alloy has been developed for use in making such castings. Any alloy can be used at the discretion of the maker, and when the castings are to be used for special purposes, alloys containing as high as 11 per cent tin may be necessary. In this article *red brass* is being considered. This term is applied to admixtures of all the commonly used metals, copper, tin, zinc, and lead, as distinguished from bronze, which is an alloy of copper with tin, with sometimes small additions of zinc, added in an endeavor to ensure soundness of the metal when it is cast.

A typical red brass is ounce metal, so called because it was originally made by mixing one ounce each of tin, zinc, and lead, with one pound of copper. This metal, which is an old alloy, is now more commonly known as "eighty five, three fives." Its ingenious originator has long been lost sight of, if he was ever known. Had he followed the modern practice of naming it after himself, this alloy might have been known as *Smithite, Jonesite* or *Brownite,* instead of eighty five, three fives.

Key Metal Harder

Now ounce metal has a little brother fittingly described as of the masculine gender, as it is made of sterner stuff, being much harder than ounce metal. It is known as *key metal,* a name descriptive of the use to which it was once extensively put, ounce metal being too soft for such a purpose. Key metal which is a stiff alloy consists of 2 ounces of tin, and 1 ounce each of zinc and lead to 1 pound of copper. Therefore the two alloys, complement each the other; the one being suitable for all purposes requiring a soft alloy, and the other is eminently suitable where a hard metal is desired.

For making sticks either of the two alloys can be used; ounce metal for a soft red brass and key metal for a hard brass. The latter alloy figured in percentage is, copper, 80 per cent; tin, 10 per cent; zinc, 5 per cent, and lead, 5 per cent. It is harder and more dense alloy than 88-10-2; casts more soundly, and because of its lead content, machines with greater ease. It is suitable for making hard brass sticks. Also it is much less troublesome to cast than 88-10-2 metals, and should be used to replace the latter alloy whenever possible. Thirty-five or forty years ago, key metal was better known than it is today, and

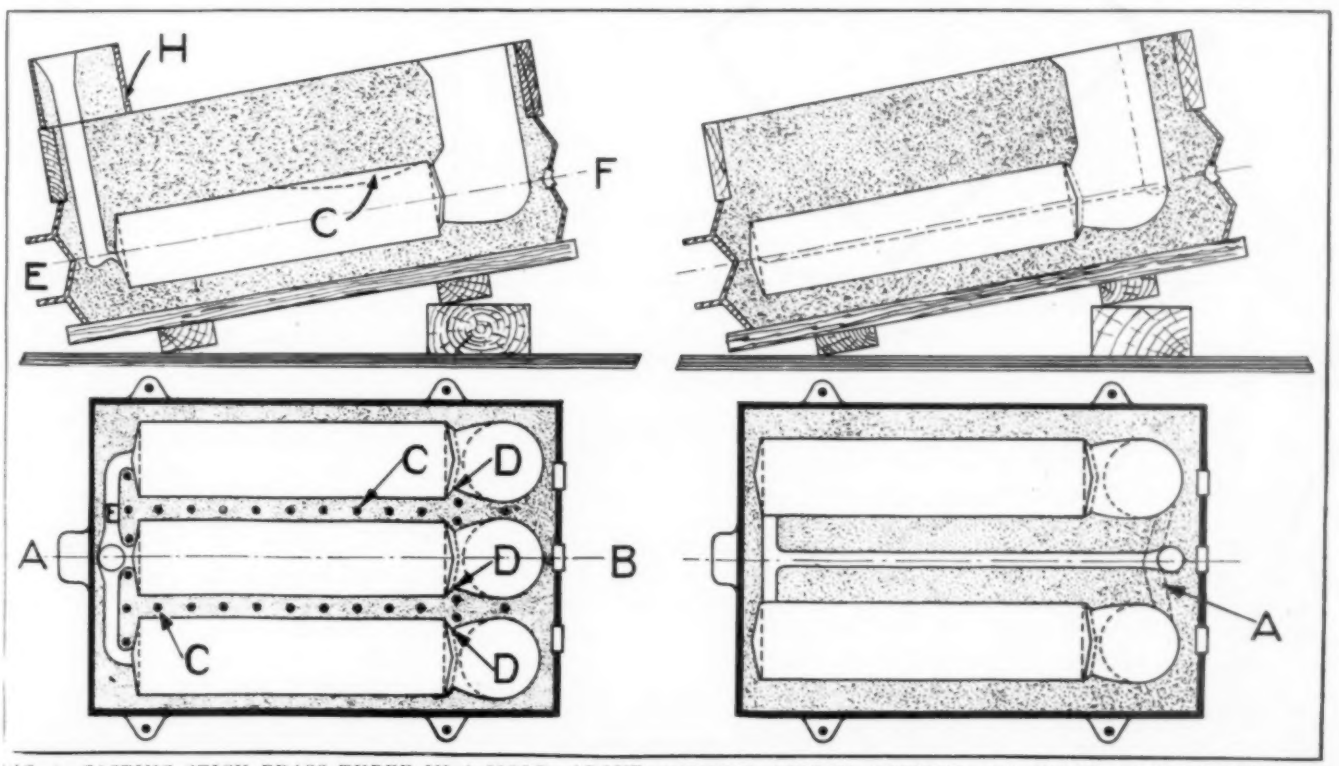


FIG. 1—CASTING STICK BRASS THREE IN A MOLD—ABOVE—VERTICAL SECTION THROUGH *A-B*—BELOW PLAN THROUGH *E-F*
FIG 2—CASTING TWO IN A MOLD—ABOVE—VERTICAL SECTION—BELOW—PLAN OF THE MOLD

like the tempering of copper, is an example of how a meritorious thing can be lost sight of in this busy world.

The smaller sizes of stick brass that range from ½ to 1 inch, and even to ½ inches in diameter, present no difficulties to be overcome in making stick castings. The patterns can be arranged parallel to one another, to fill the flask, with the runner placed across one end of the assembled patterns, and gated into the end of each. However, if the alloy to be cast is manganese bronze, a different method of gating will be necessary to get clean castings, even in the case of sticks of such small diameter as ¾ inch. If the bronze is expected to meet specifications as to physical strength, based on what is obtained from properly cast test bars of that particular formula, an entirely different method of molding and feeding, which is more than twice as costly will be required to obtain castings sound to the core and of the same structure throughout their length.

The larger sizes of sticks, roughly from 2 inches diameter upwards often have excessive shrinkage which results in a casting with a depression in part of its length as shown by the dotted line at *C*, Fig. 1. This illustrates one method of casting sticks 3 inches in diameter. Usually the defect can be traced to the desire, almost amounting to an obsession with some, to keep down the remelt of metal by curtailing gates and risers. In the majority of cases the result from this practice will be just the opposite to that expectation; namely a greater remelt than when a more generous policy is followed in regard to the amount of melted brass allowed the castings.

The investigation to ascertain the melting and fuel losses in present brass-melting practice conducted by H. W. Gillett, of the United States bureau of mines determined the average proportion of metal melted to weight of castings as two to one. In the case of extremely light castings a ratio of 3 pounds of liquid bronze to 1 pound of castings prevails and a ratio of 3 pounds of liquid brass to 2 pounds of castings is low. We are now considering straight cylindrical castings 12 inches long by 3 inches in diameter, using an alloy of 85, 5, 5, 5. This alloy weighs 0.31 pound per cubic inch, and a casting of the size mentioned will contain 84.87 cubic inches, which gives 26.31 pounds as the weight of the casting, or allowing for little inequalities and roughness, the casting will weigh 27 pounds. If 1½ pounds of metal are necessary to pour a pound of casting, 40½ pounds will be required for each casting. Therefore about 120 pounds of molten metal will be needed to pour a flask of three castings as shown in Fig. 1, and 81 pounds to pour a flask containing two castings, as shown in Fig. 2. This amount will allow, for gates and risers half as much metal as the casting weighs; and we have the statement of an authority, made after a careful investigation carried out by the United States government that this proportion of metal melted is low.

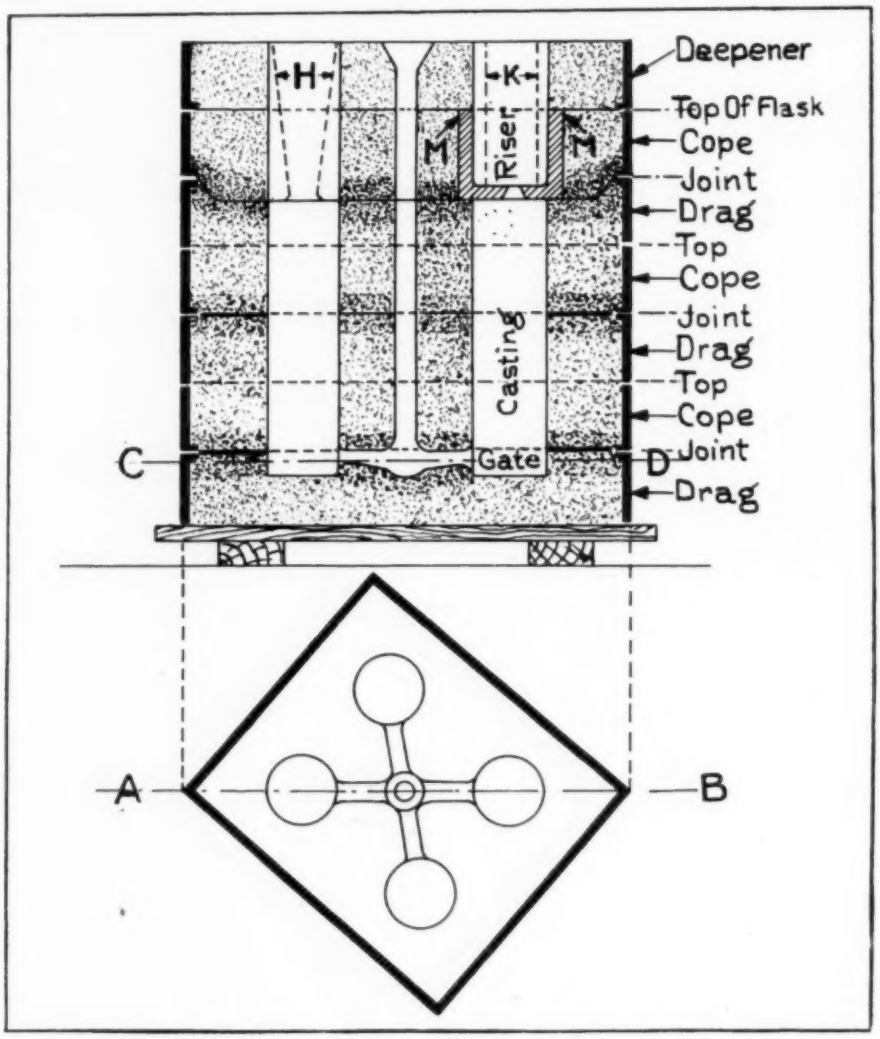


FIG. 3—CASTING VERTICALLY—ABOVE—SECTION THROUGH *A-B*—BELOW—SECTION THROUGH *C-D*

High Percentage in Casting

The weight of each riser shown at the right in Figs. 1 and 2 will be approximately 13½ pounds, while the gate and runner will approximate 3½ pounds per casting, or 17 pounds of remelt to 27 pounds of casting. While this is a little more than the ratio of 1½ to 1, it is considerably less than the common melt of 2 to 1, and therefore can be considered good practice, instead of wasteful practice. By putting three sticks in a flask as in Fig. 1, the ratio of liquid brass to solid casting is rather less than when two are placed in a flask as in Fig. 2. In the former case the weight of the gate counted against three castings, and in the other against only two castings. However, if the gate and runner shown by the dotted line at *A*, Fig. 2 is used, which will conduct the molten metal into the base of the feeders, instead of down to the opposite end of the casting, the amount of metal consumed to pour a casting will be about the same as for Fig. 1.

Either form of gate as illustrated in Fig. 2, can be used successfully, but just how successful the gate at *A* will prove in producing good castings will depend upon how clean the metal will run, and this again is independent on how much zinc it contains. The long runner with a small gate at the end of the casting farthest from the feeder can be depended upon to produce the cleanest castings, particularly if a skimming core is inserted across the runner. The gates, either with the long or the short runner, must not be made so large that it will be impossible when

pouring to keep the sprue filled. This is particularly important with the riser gate at *A*, Fig. 2. The long runner conducts the molten brass to the lower end of the casting cavity and after gently filling up that end to its own level causes the metal to flow uphill in the direction of the length of the casting, also rising vertically in the direction of the diameter of the casting. By thus flowing in two directions at once the energy of the molten metal is expended and its cutting action on the mold is reduced to a minimum. Thus, it is that castings poured from the end in this manner always come the cleanest, which may be translated as meaning that the end gate will produce the smallest percentage rejects due to dirt and sand in the castings.

Mold Filled Gradually

Fig. 1 shows a different method of attaining the desired result of a gradual and gentle filling of the mold. With three castings in a flask 18 x 12½ x 5 inches total depth, it is not possible to have the sprue at the same end as the feeders and also use a long runner as shown in Fig. 2; therefore, the expedient of placing the sprue at the lower end of the flask is adopted. This makes necessary the bushed head, Fig. 1, on top of the sprue, otherwise, the riser would fail to fill up, due to the inclination of the flask. In this case also, the pouring sprue could be located at the feeder end by molding the patterns close to the opposite end of the flask, and then gating into the base of the feeders in a manner similiar to that shown at *A*, Fig. 2. The objection to this latter method is that when the flasks are tilted, the liquid brass dashes down the incline with considerable momentum, then recoils from the end of the mold, thus producing a strong cutting action both at the mold end and along its length in the drag section. This can be avoided to a considerable extent by placing the mold flat, instead of on an incline. However, such a position is not so favorable to feeding the casting, as the assistance of the force of gravity is largely lost. As a consequence it may be found advisable to increase the height of the head by putting on another half of a flask, or a wooden upset. If bushings were used they would consume as much time as the ramming of the extra flask part.

Figs. 1 and 2 show a flask of standard shape, 12½ inches wide, 18 inches long, and having a depth of 5 inches. This is one of the most frequently used standard sizes, and also the smallest size flask that can be used to mold these sticks horizontally. The patterns are drawn to the same scale as the flasks and the illustrations thus correctly represent the appearance of the mold when made. In Fig. 1 the plan of the mold shows how little space is left for sand when three patterns are molded in a flask. The black dots show how the sand will have to be nailed to make the mold secure, so the castings will not *break in*. The nails should be long enough to permit their being driven into the bottom board sufficiently to have a stiff anchorage. As a flask of the type illustrated will have three holes at one end instead of a lifting lug, these holes will require to be securely closed against a run out. This is usually done by placing a strip of sheet iron against them on the inside of the flask, in both cope and drag. This strip is rammed up with the flask, and unless this precaution is taken the risers, as they fill with metal, will surely push out the plugs of sand, filling the holes, and the mold will be lost.

When two patterns are molded in a flask instead of three, as shown in Fig. 1, sufficient sand will remain between each casting to make a mold strong enough to hold the pressure of the molten metal. Therefore, nailing will be unnecessary, although it will be necessary to bridge across the end holes with strip iron as before because the same need for it exists. When the extra work entailed by nailing and making the sprue bushing is taken into consideration, it will be evident that little, if anything, will be gained by molding three instead of two castings in a flask.

Nailing Found Necessary

The molding sand should be of a coarser grade for these castings than is used for fine brass work, and the drag half of the mold should be rammed hard. As illustrated, only about an inch of sand is allowed between the casting and the bottom board, and when the latter is of wood it will be an economy to put a 2-inch upset on the drag, thus allowing three inches of sand between the casting and the bottom board. Unless this is done the bottom boards will be destroyed in a few heats. Iron or aluminum plates can be used, and the upset then will not be needed. However, with metal plates as bottom boards, it would be distinctly unsafe to put three patterns in a flask and simply stick a few nails between each, short enough to be driven flush with the drag joint without touching the bottom plate; because, as the nails are not anchored the pressure of the molten metal will be sufficient to break away the sand and one casting will be joined to the other. With three patterns in a flask an upset is a necessity, as then there is enough depth of sand under the pattern to permit nails to be used long enough to secure the partition between the castings.

Four Patterns in a Mold

Fig. 3 shows the vertical method of molding such sticks four patterns in a mold. The size of the flask is 14 inches long; 12 inches wide, and 6 inches deep. Three and a half flasks are required to make the mold as shown. In the illustration, three partings are used, but only two are really required; one at the top, and the other at the bottom of the patterns. The check is 12 inches high, cope 6 inches and drag 3 inches. Allowing for the bottom board, the total height of the flask will be around 37 inches. Its construction will require as much time, if not more, than two of the molds made as in Fig. 2. The sand should be of an open grade, having good binding properties. It must be worked rather dry and rammed firmly and uniformily, otherwise the castings will be swollen at the lower end. Fig. 3 shows the patterns sunk 1 inch into the drag to facilitate cutting the gate in the drag, thus avoiding the necessity of rolling over the cheek. This also allows another inch depth of cope. To feed the castings, sometimes a sullage head is placed on top of the mold as illustrated by the straight lines showing a continuation of the castings to the top of cope, in Fig. 3. If this method is used and the riser is 6 inches high, each casting will require as much metal to pour it as either of the molds shown in Figs 1 and 2. If an attempt be made to save metal by curtailing the size of the riser, the taper shown at *H*, Fig. 3, can be depended upon to draw down into the casting every time, leaving a tortuous cavity after it is cut off, and the result will always be scrap, even after attempts made to *burn it in*.

Small Riser Not Recommended

Should it be thought a riser of smaller diameter can be used with success that shown at *K*, Fig. 3 could be tried, but is not to be recommended. A riser or feeder is a necessary evil; its object is to provide a reserve of liquid metal, so situated it will descend by gravity into any cavities formed in the casting as the result of the shrinkage due to solidification. Obviously, if the riser congeals before the casting, it will not fill shrink cavities in the latter. Some foundrymen even claim the riser draws from the casting, but such action is impossible

when the riser is higher than the casting. The hole in the casting is produced by its own shrinkage, for the riser, as such was a complete failure and might as well have been omitted.

The chances of the riser solidifying before the casting are always extremely favorable, even when it is of the same diameter as the casting, because as a rule, not only is there a much greater mass of metal in the casting itself, but it is insulated and kept hot by a blanket of sand, also by the heat of the riser itself, while the latter, not only is of smaller bulk, but is also exposed to the chilling influence of the atmosphere.

All this curtails the power of the riser to feed down into the castings; a fact recognized unconsciously by molders when they use a pumping rod to keep the riser open. Both pumping rods and heavy risers can be eliminated by so molding the casting that it will be certain to solidify first. This is done by chilling the casting and thus hastening its moment of solidification. One way of doing this is by the use of a carbon mold which will be described later. Another way of attaining the same end is to keep the riser warm so it cannot congeal before the castings. This can be accomplished by using a clay liner for the riser. Liners made of fired clay, and shaped somewhat like a short fire pot have been found of value in this connection. The hole in the pot bottom of the liner is somewhat larger than the hole in a flower pot, and after the cheek is rammed, and the cope commenced, the liner is set with its hole centrally over the pattern, and is rammed up in the cope as a part of it. Just before the casting is to be poured the lined riser is warmed to drive off moisture that may have been absorbed. After the liquid metal has filled up the casting it rises through the hole in the bottom of the liner and gradually fills the latter. The warm, dry, nonconducting clay keeps the metal in the riser fluid until after the casting has set with the result that any cavities that may form in the casting during the time of solidification are filled from the reservoir of liquid metal above. A clay lined riser is shown at *M*, Fig. 3. It will be noted that it is a simple matter to detach the riser which can be broken off while hot as the connection between it and the casting is relatively small.

When stick brass is molded, as in Figs. 1 and 2, the castings should be shaken out just after they have cooled to below a visible red heat, then the risers and gates can be broken off by hitting them a smart rap with a hammer. The blow should be directed in a straight line with the length of the casting; first, striking towards the casting, and then away from it alternately until the riser is detached. When the riser is filleted, as shown in the illustrations, it will break off cleanly without breaking into the castings. When removed from the sand while hot, the castings can be cleaned by using a coarse file along the fin of the joint and sandblasting or using a scratch brush and then grinding off the ends to make them ready for shipment to the machine shop.

How and Why in Brass Founding

By Charles Vickers

Aluminum Becomes Hard Through Remelting

We would like to be advised as to the feasibility of casting aluminum utensil handles, ears and kettle spouts in steel molds. Are there any machines for casting those objects? We find that in melting aluminum, the more frequently it is melted the greater the loss of the metal and the harder the alloy becomes. Can you suggest any method of melting that will not produce this hardening effect? The aluminum ingots made for rolling purposes, tear during the rolling, after they have been hardened by this remelting process.

To make aluminum castings successful in metal molds, in other words, die castings, it is necessary to be equipped in a thorough manner. We believe it would be necessary to build your own machines, and devise the methods yourselves; at least most of the successful die casters have had to follow this road. While the ears and handles would not be difficult, the spouts would present quite a problem to get them in chill molds. We doubt whether such chill castings could compete with these made on a molding machine, using sand molds for such work. In melting aluminum the waste of metal can be kept down by the use of a small piece of zinc chloride as a flux. The fused chloride is best to use, and a piece the size of a hazel nut should be thrown onto the surface of the aluminum. The metal then should be stirred around to recover the metal from the dross. Sometimes it may be necessary to repeat the fluxing, if the first addition fails to entirely clear the surface of the metal. Use just as little chloride as possible. To prevent hardening of the aluminum by remelting, keep the temperature as low as possible. If the almuinum is not allowed to get more than faintly red in color when molten it cannot take up impurities that will harden it. Also it will only oxidize slightly, and if it is good aluminum to begin it should not be greatly hardened by remelting several times. The method employed for melting the aluminum exercises an important bearing on the subsequent physical properties exhibited by the metal. It must be watched constantly and closely so that at no time will it be above the critical temperature.

Bronze Bearings May Be Poured Too Hot

We are casting phosphor bronze bearings weighing about 600 pounds each, melting the metal in a gas-fired, noncrucible furnace, and using a mixture of copper, 84 per cent, tin, 10 per cent lead, 0.73 per cent zinc, 4.67 per cent; and phosphorus, 0.11 per cent. We have trouble with same of them leaking on the test floor, and we think the melting may be at fault. The defective castings present a badly pitted appearance on the machined surface.

Use hardwood blocks as a source of charcoal when melting the copper, if it is in ingot shape because during the time the blocks are burning to charcoal they will take up the oxygen in the atmosphere of the furnace and protect the copper, before it melts down and gets under the charcoal blanket, and as the woodblocks burn they, of course, form charcoal. Most of the oxide in a melt gets there before the copper melts. Therefore, if wood blocks are used, some protection is afforded to the copper before it is melted. After it is melted it is safe under its blanket of charcoal. That

is the best that can be done while melting. If the castings are porous despite these precautions it is not the fault of the furnaceman, and that worthy is entitled to exoneration. The next step would be to discover if the phosphorus is not causing the porosity. While alloys several times higher in zinc than the one here given, have been phosphorized up to 1 per cent and over, and have produced sound castings for bearings, nevertheless, the time consumed in pouring was remarkable. Three or four men had to sand around for possibly thirty minutes while the metal was taking its time to get to the pouring temperature and it is a question whether such alloys pay. The porous castings in this case may have been poured too hot. Alloys containing zinc and phosphorus are very delicate as regards pouring temperature, therefore, many times it will pay to cut down on the phosphorus. In the case of this particular alloy, better success will be enpoyed if two ounces of 15 per cent phosphor copper per 100 pounds of metal are used, instead of 0.11 per cent phosphorus, which is too much for that particular alloy unless time and money can be spent to discover the correct pouring temperature.

Clean Castings Poured on an Incline

We send for your inspection a bronze escutcheon, on which the polished surface is marred by extremely fine specks, the largest about the size of a pin point. We would like to know what causes these defects. The alloy consists of copper, 80 per cent; zinc 7.5 per cent; tin, 5 per cent, lead, 2.5 per cent which is melted in an ordinary coke-fired furnace. The sample we send was deoxidized by 1 per cent phosphor tin, in place of the same amount of ordinary tin, but the results are no better. We are careful in melting and use charcoal. The castings are gated on one end with a broad gate, and we wonder if changing the gate would help.

When a casting has to be polished it is never advisable to run the metal in directly from the root of the sprue, because it is almost certainty that blemishes will appear when the surface is cut down, and more especially if the casting presents a broad, flat surface. These castings are heavy enough to run from one end, but instead of shooting the metal in, use a little diplomacy. In this case place the gate and sprue at one end, and at the other end put on a small riser. Under the riser end of the flask place a piece of 2 x 4; the sprue end must *not* be reamed out to a head, because it is necessary to place a bushing on it to raise the head. The metal thus will run up hill and out at the riser, and provided the metal is clean, and the gate does not cut, the casting will be speckless. Bronze castings 12 feet long 1 foot wide have been run in the above manner to produce perfect castings. The metal appears to be oxidized in spite of the addition of phosphor tin. We suggest that deepeners be used on top of the pots to get the entire charge in when cold. Cut the bottom off an old pot and use the bilge part for the deepener, and use one and a half ounces of 15 per cent phosphor copper placed in the bottom of the pot with the cold metal, and no phosphor tin. This amount of phosphor copper is sufficient for 100 pounds of the alloy.

Crucible Not Suitable Melting Medium

We have on hand a quantity of material which shows on analysis approximately, 85 per cent lead sulphate and 15 per cent lead oxide. We wish to be advised of any methods that are available for reducing this to metallic lead.

No methods are available in a foundry for reducing a mixture of lead oxide and lead sulphate. It is a proposition for a smelter, as it cannot be reduced in crucibles, and it is necessary to put it through the lead blast furnace. Where a blast furnace is not available a reverberatory furnace sometimes is used. The mixed oxides and sulphates are mixed with a flux consisting of coal, glass, salt and fine iron scrap, in the proportion of 18 per cent coal, 26 per cent glass, 13 per cent salt, and 43 per cent iron scrap and the whole is smelted at a temperature of about 1200 degrees Fahr. If the foregoing material was melted in a crucible it would cut the crucible away, and ruin it before one heat could be poured and if melted in a non-crucible furnace, the firebrick lining would be ruined.

Moisture Condenses no Small Steel Wires

We send for your inspection a small brass casting with which we are having considerable trouble. Two small steel wires, about 1/16 x 2 inches are cast in, and we have cut the casting at these points to show how blow holes form around the wires. We have tried to prevent their formation by tinning, pickling, coating with copper sulphate, and by using different types of gates and risers, but without success. The analysis of the metal is; copper, 89.7 per cent; tin, 4.2 per cent; zinc, 2.2 per cent; lead, 3.9 per cent, and each crucible contains 80 per cent virgin metal and 20 per cent back stock and chips. Can you suggest a remedy and advise us if the trouble is due to the wire, the casting analysis, methods of melting, or methods of treating the wire before placing in the mold.

The holes are confined to the vicinity of the wire and therefore it is apparent that the trouble is not due to the metal. The holes are produced by steam which in turn is produced by the action of the hot metal on moisture condensed on the wires from the atmosphere of the mold. There is always moisture in the air within a sand mold, and if anything cooler than the sand is introduced, the moisture condenses thereon. Because of this, tinning, copper plating, or pickling has no effect on the formation of holes, because the moisture will condense just as readily on the treated as on the bare iron surface.

One of the wires is located adjacent to the gate and all the metal flows over it in filling the mold. This wire has produced only one small blow hole because it was heated before the flowing metal came to rest. The wire farthest from the gate, which was simply surrounded by the molten metal has produced a mass of blow holes. It is evident, therefore, that a shrink ball at this point would assist in getting sound castings, because metal would be flowed over the second wire also, carrying the blowholes with it. A slight film of kerosine oil on the wires will help matters, also keep the wires as warm as possible, and pour off more frequently. In making the molds, never allow hot sand to be used as a backing, as the steam will film the wires with dew.

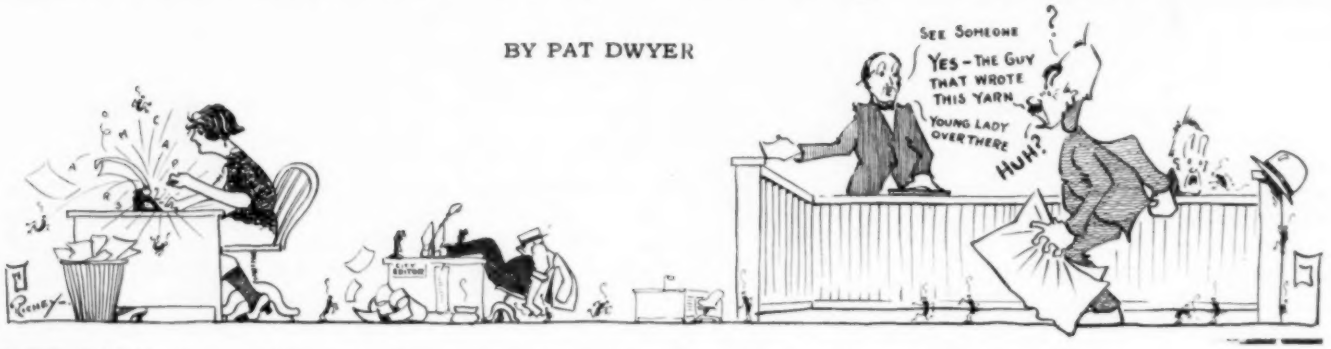
Plates Are Discolored

Brown and yellow spots appear in front of the gates on aluminum plates 11 x 11 x ¼ inches. We have tried gating them both in the cope and drag and also have tried by choking the gate. The metal is poured at a light cherry color.

If these spots are only surface discolorations they may be removed by an application of dilute nitric acid. The castings must be washed afterward. The spots are due to the high temperature at which the aluminum is poured and as long as this practice continues the discoloration may be expected. There is a possibility that by dusting the molds with powdered rosin and charcoal in equal proportions and then blowing off the surplus the discoloration may be prevented.

Bill Discusses Pulley Molding Problems—III

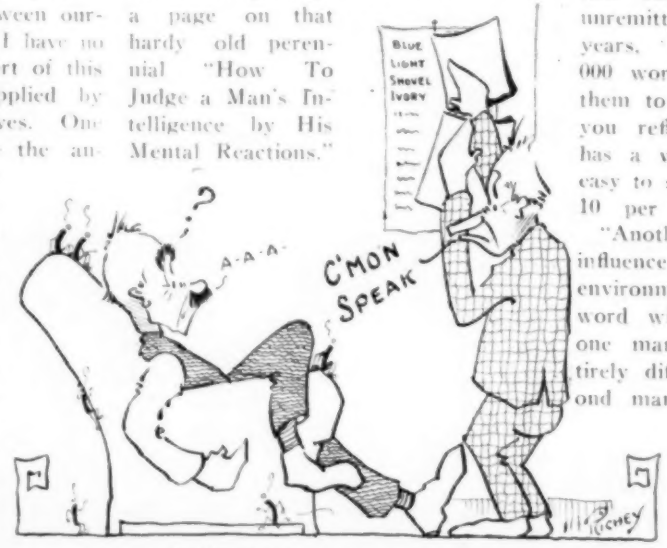
BY PAT DWYER



MANY times while skimming idly through the magazine section of the Sunday newspapers I have wondered if the writers of the various articles expect to be taken seriously, or if they pause occasionally in the throes of composition to stick their tongues in their cheeks, or smile discreetly up one, or both sleeves. Considering that many of these writers are ladies, it imposes a severe tax on one's gallantry and chivalry, to say nothing of one's credulity, to imagine them indulging in such an unladylike proceeding. However, when in fancy you hark back to the days of your childhood—hark is good—and remember how skillfully, adroitly and venomously, the little girl next door could expose that sharp little insulting member at the slightest provocation, the probability of the grown up little girl indulging in more discreet gymnastics of the same, or a similar character, does not seem so remote or impossible. It is possible that some of these feature writers conceal their identity under a euphonious pseudonym and since literature—save the mark—knows no such limitation as sex, Grace Darling may be known in private life and among her particular cronies under the prosaic title of Jerry McNulty. Between ourselves, I am willing to admit I have no evidence to advance in support of this contention, beyond that supplied by some of the writers themselves. One of their favorite themes is the anonymous writer whose books created such a sensation before it was discovered that he or she as the case might be, really was she or he. Having admitted that I am skeptical in regard to every feature connected with these essays I cannot, with a good grace, or consistently, invoke them as evidence to support any claim touching on the identity of the writers. Really, the subject is of little importance and it is quite probable that these writers care as little for my opinion as I do for their's. They have an advantage in the fact that the fantastic creations of their brains and typewriters are broadcasted every Sunday among hundreds of thousands of readers and while many of the readers may feel as I do in regard to the value of the material, not one in a million will take the trouble publicly to challenge any of the statements.

The old admonition to dare to be a Daniel, dare to stand alone, as a rule does not appeal to mankind and that explains to a certain extent why I appealed to Bill for his opinion on the subject. Knowing his radical tendencies I felt reasonably certain that his opinion would coincide closely with mine and no matter how brave you are or how willing you are to stand alone, there is a considerable measure of comfort in knowing that others are willing and if necessary will stand with you. In this instance I was not disappointed.

"Well" said Bill, "I'll tell you. I don't know if the birds who write that piffle believe in it or not, but I notice that at some period in their career every single one of them does a page on that hardy old perennial "How To Judge a Man's Intelligence by His Mental Reactions."



MAKE YOUR ANSWER SNAPPY

You are warned in the first paragraph that a list of words will be found further down the column together with a corresponding list of the complementary words that instantly should leap into the mind of an intelligent person. You are invited to cover the second list with your hand or a piece of paper, time yourself going over the first list, then compare your list of words with the list that was covered and also compare your time with the official time and then you will be in a position to determine whether you are normally intelligent, or, on a par with the inhabitants of our institutions for the feeble minded.

"I am willing to admit that the test might have a remote significance if every single word in our language had a single, definite meaning, but you know that hundreds of them are capable of having more than one meaning. They are spelled alike, pronounced alike and it is only by reference to the context that one can determine, for instance, whether blue means a color or a condition, or, whether light has reference to illumination or gravity. The late Mr. Webster and his equally famous English contemporary Mr. Johnson, by unremitting toil extending over many years, collected approximately 500,000 words, all different, and credited them to the English language. When you reflect that the average person has a vocabulary of 5000 words it is easy to see how he usually grades about 10 per cent in a test examination.

"Another feature exerting a direct influence in this respect is a person's environment and training. A certain word will conjure up one image in one man's mind and something entirely different in the mind of a second man. Suggest the word shovel and the first complementary word that flashes into a contractor's mind is steam, the householder will say snow, or coal and the foundryman will say sand. In the

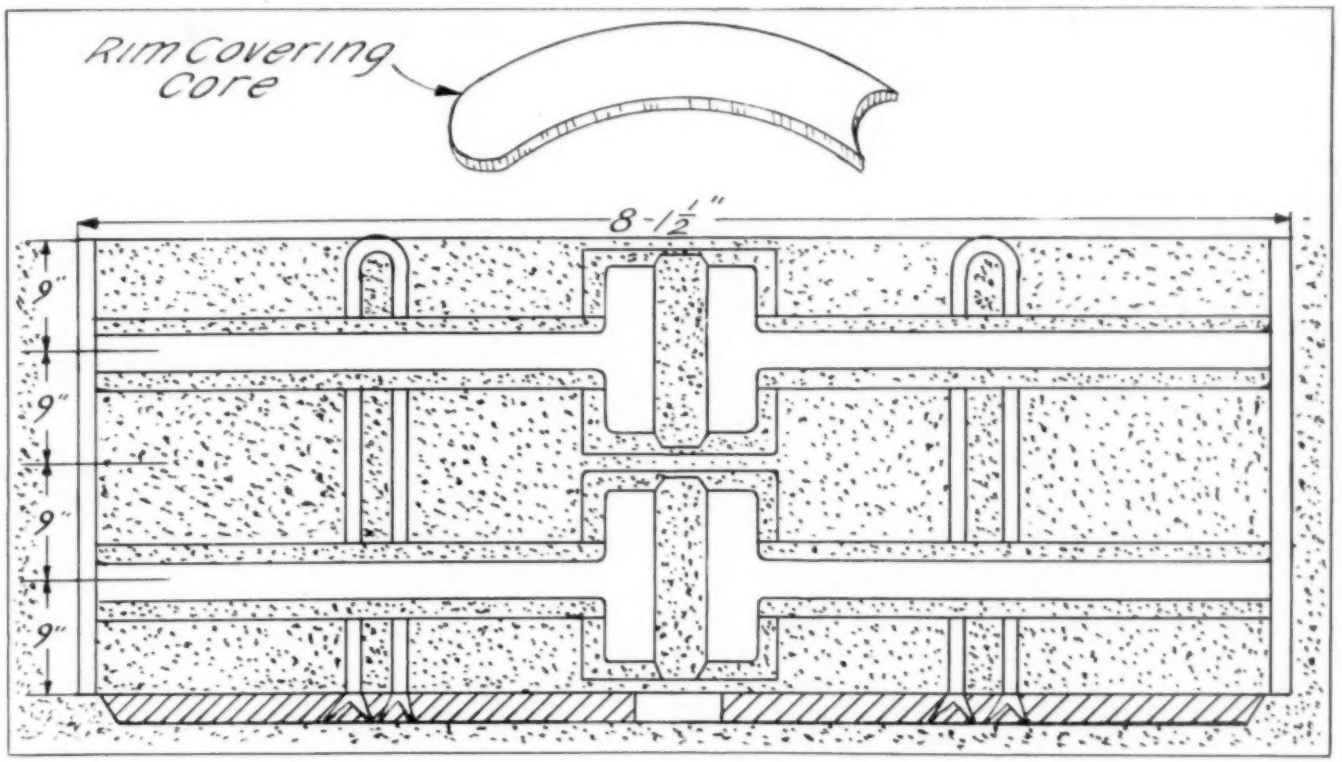
same manner set down the word riddle and what mental reaction do you get? The sailor will think of a sail or a target shot full of holes, the average man will think of a puzzle which may find expression in any one of a half dozen names, the molder will think of a flask, a shovel, a sand pile or perhaps a back ache and the student probably will think of the Sphinx of Egypt, the greatest riddle of all time. Of course it may be argued that the later two definitions may bear a more or less tangible relation to each other, in that the presence of vast quantities of fine sand in the valley of the Nile may be taken as evidence that the Sphinx was a mighty riddle in more than one sense.

"While we are on this subject of words and their suggestions I should not be surprised to find that the word Egypt calls up in your mind visions of pyramids, camels and, if you have been to the movies recently, bands of wild Bedouins who spend all their time galloping around the desert where the sand is over the horses' ankles, or whatever it is they call that part of the legs. No wonder they are wild. To my mind Egypt means Cairo and Cairo suggests Chicago, a perfectly coherent and logical train of thought as any person whose memory embraces the World's Fair in Chicago can testify and talking about Chicago reminds me of a witty lad there engaged in the iron and steel business. His latest pleasantry has to do with a riddle. While discussing equipment and supplies with a dealer, a visitor in his office asked him what was a riddle. Without the quiver of an eyelash or in any way indicating that he was landing him a swift one under the guard he said: 'I don't know, you will have to guess.'

"I am willing to admit that a knowledge of words and their uses may be an asset to a man, but as a test of his intelligence, or a gage of his particular fitness for any job outside that of a professional spellbinder, you might just as well attempt to grade men by the size of their collars, or, their taste in neckties. It is a notorious fact that the most important men in any industry talk the least, but when one of them, for instance, says: 'You're fired' believe me you *are* fired and all the king's horses and all the king's men and, for that matter, all the words in the dictionary, will not put you back on the payroll.

"Now that apparently we are beginning to creep out of the slough of despond and customers are ordering castings again, I have occasion to hire a few additional molders accustomed to heavy work, both green and dry sand. I am not unduly impressed by the fact that a candidate is a voluble character or that he sprinkles rare and choice words in his conversation. On the other hand I don't set him down for a hopeless case because his vocabulary is limited. I show him the class of work we are handling and if he intimates in one word, or in one hundred words, that he is familiar with it I set him to work and before he is on the job an hour I have his number in a more satisfying and convincing manner than if he had taken 40 theoretical examinations. A bluffer may get by for some time in many places, but not in a foundry. The sequence of operation, especially on heavy work hinges to such an extent on starting the job properly that unless a man is competent he betrays his ignorance immediately and he is dropped without the formality of being asked to tender his resignation. In unusually busy times he may be kept on and shifted to some plain and simple job in the hope that he may be of some service, but in the great majority of cases he is a disappointment and is one of the reasons why foundry foremen lose their hair from continual worrying and scratching, and why those of a nervous temperament have their finger nails gnawed down to the quick.

"In foundries specializing in power transmission machinery, pulleys are made in considerable quantities and naturally the men employed in these foundries develop speed and skill in making the molds. Rigging and equipment is provided so that the molders lose no time in deciding how they are going to handle the job. Through



ABOVE—ONE OF THE SEGMENTAL COVERING CORES FOR THE RIM BELOW—SECTION OF COMPLETED MOLD SHOWING LOCATION OF ARM AND HUB CORES 1½ INCHES ALLOWED FOR CONTRACTION AND FINISH

repetition the work is standardized and naturally is of a routine character. These conditions do not obtain in the ordinary jobbing shop where pulleys occasionally are made. Where the face of a pulley is comparatively narrow in proportion to the diameter of the wheel, the best method probably is to build up a ring and turn it to the required size to serve as a pattern. Under certain circumstances it may be advisable to make a full set of arms with hubs, but usually it is more economical and convenient to make a half arm corebox and make the arms in dry sand cores to be set inside the ring pattern. Where the face of a pulley is unusually wide the jobbing foundryman dispenses with a ring pattern and employs two sweeps and a corebox to make the mold. It is apparent that the most extreme care and accuracy must be observed, in setting the sweeps, the cores and in assembling the mold so that the resulting casting will balance and run true when assembled in its place as a component part of some industrial unit. Many wheels run at terrific peripheral speeds and the least deviation in balance will result in rupture.

Alternative Methods

"Either one of two methods may be adopted in forming the mold. If no suitable flask is available the entire mold may be made in the floor by providing a circular lifting plate on which to build the core or body of sand forming the inside part of the mold. This part of the mold is lifted out and set to one side while the exterior face of the mold is being formed. It afterward is returned to its place and the space between the inside body of sand and the outside face of the mold constitutes the mold for the rim of the wheel. In the second method, the body of sand forming the inside of the wheel is not disturbed. It is allowed to stand on a drag or on the floor and a flask equipped in a suitable manner with some form of lifting device, is employed to *check-off* the outside. After the mold is finished the cheek is returned to its place and either weighted or clamped to hold it in place while the mold is filling with iron.

"Consider briefly, the sequence of operation in making a pulley 8 feet diameter, 3 feet across the face and provided with two sets of arms. Under certain conditions a loam mold would be the most satisfactory form in which to make this casting. For example if several castings were needed, the outside wall would serve without rebuilding, representing a considerable saving in time. In some cases the only molder in the shop accustomed to the use of sweeps is a loam molder and naturally he is allowed to make the casting in the manner with which he is familiar. A casting made in loam practically is insured against distortion, cold shuts, blowholes and other forms of trouble incident to castings made in sand molds and for that reason a man may be inclined to adopt that method. However perfectly satisfactory castings are made in sand molds and since the methods of sweeping the molds and later assembling them are identical, irrespective of the material employed, we shall assume for purpose of illustration that the mold is made in sand and skin dried.

"Every jobbing shop is provided with a spindle, seat and arm and therefore the only pattern equipment required will be two sweeps, one half corebox to form the arms and one corebox to form the hubs. Usually a stock corebox is available to form the center core. In the event that the wheel is to be split, of course it will be necessary to provide a corebox and core prints for that purpose. However that is only a detail. The wheel may be poured with the top of the rim open, or covered. Wherever possible it is preferable to pour the mold open because the method affords a workman provided with a ¼-inch rod an opportunity to look down upon the rising iron and dislodge any little lumps of dirt that tend to form and stick in front of the arms. In the event that for any reason it is desirable to cover the rim flat segment cores like those shown in the illustration may be employed. The concave and convex ends on this core render it universal in its application so that the cores made from one box will fit almost any circle. The cores may be held down by small weights, by a circular plate or by a cope rammed full of sand on top of them.

Pit Molding

"Where, for want of a flask or for any other reason, the mold is made in a pit in the floor, a level bed is swept on the bottom of the pit and on this bed the lifting plate is rammed down solidly. Sand then is rammed all over the remainder of the bed and swept off flush with the top surface of the plate. Measuring up from the bottom plate suitable marks are placed on the spindle to indicate the position of each of the hub cores. With two sets of arms equally spaced in a distance of 3 feet, it is apparent that the center of the first arms will be at a point 9 inches above the bottom and the center of the second set will be 9 inches from the top, with a distance of 18 inches between centers on the two sets. In arranging a bed on which to set the arm cores the thickness of the core must be taken into consideration and assuming in this instance that the half core is 4 inches thick, then the body of sand destined to form the interior of the mold, first will be rammed to a height of 5 inches. At this point the lower half of the hub core and the first set of arm cores are adjusted true and level and then the sand is rammed to a height of 23 inches from the bottom, at which point the second hub and set of arms are placed in position. The sand then is rammed to the top. The inside sweep is fastened to the spindle arm and the block of sand is trimmed to the correct shape. The sweep is removed and the crane is hooked on by three chains terminating in turnbuckles to long loops in the lifting plate. The entire body of sand is lifted out of the pit, set up on blocks, blackwashed and skin dried.

"After the exterior wall of the mold has been rammed up to approximately the proper height, the outside sweep is employed to impart the exact diam-

WHEN YOU COME TO THE END OF A PERFECT DAY, DON'T SPOIL IT

eter. The wall is blackwashed and dried and then the interior part of the mold is picked up by the crane and returned to its place. Where the mold is covered by a plate, or cope, the weights are applied in the usual manner. If the mold is to be poured open, it will be necessary to bed a plate on top of the interior part of the mold, preferably before it has been swept to shape. When the mold later is closed long binders are placed, extending from side to side of the mold. The weights are placed on the binders and the plate is wedged down from the binders. In addition to this precaution it is customary on large wheels to clamp the arm core halves together to prevent them straining apart under the pouring pressure. In the second method which I mentioned the procedure is different to some extent. For instance—."

"Never mind the second method," I said. "One of those wheels should be enough for a day. Get the second set of cores started, and have the night men bring in a flask. It will be time enough to start the second wheel tomorrow."

"There may be some truth in what you say," said Bill, "and there also is a certain measure of truth in what the old colored lady said when the mistress asked her to do a little extra work at the close of the day: 'Go 'way,' said she. 'Go 'way. When Ah wo'ks Ah wo'ks ha'd an' when Ah rests Ah sits deep!' "

Utilizing Steam from Waste-Heat Boilers

WASTE in manufacturing operations is so great that one wonders why it is allowed to continue on such a vast scale. Possibly the chief reason is that the cost of stopping it nearly equals, or even overbalances, the advantage to be gained by conserving. One of the greatest sources of waste in the malleable iron foundry is the heat which is allowed to pass up the stack of the air furnace in which the metal is melted. Losing only a few hundred degrees of its temperature to the metal in the furnace, the gas passes into the stack at a temperature high enough to melt iron. This is illustrated in air furnaces used in the gray-iron foundry which are built so that iron can be piled in the base of the stack to be melted by the outgoing gases.

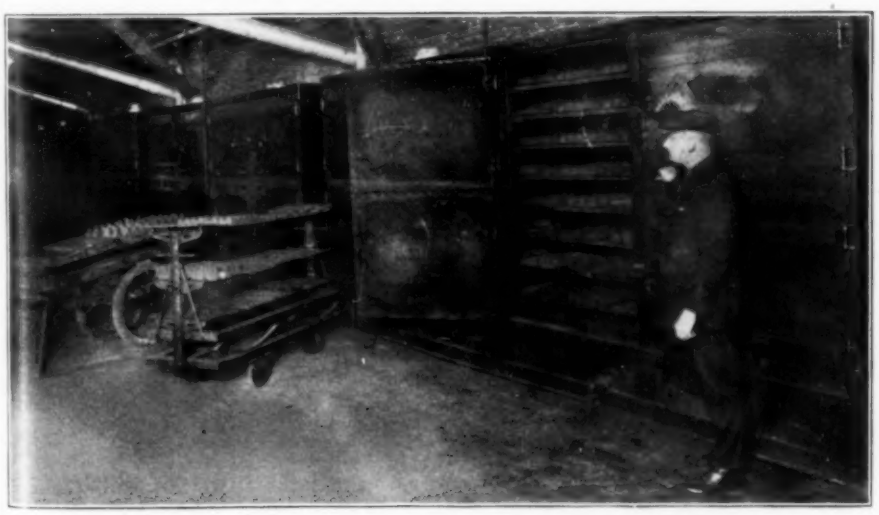
Similar design is not used in the malleable-iron foundry but some companies have found it economical to install a waste-heat boiler betwen the stack and the furnace. Here is shown the expense entailed in saving what otherwise would be wasted. Enough advantage must be secured from the boiler to compensate, for the depreciation and interest on the money it required to install it. Some upkeep must also be charged to the boiler. Again a use must be found for the steam generated, or it is of no commercial value. One of the difficulties is that heat is not maintained in the furnace at all times. This can be overcome to an extent when two or more furnaces with waste-heat boilers are operated in the same shop.

In the winter the steam may be used to heat the foundry during the day, but an auxiliary heater must be provided to keep the foundry warm during the night. However, this need not be large as the foundry which will have been warmed by the waste-heat steam in the day only need be prevented from cooling below the freezing point at night. Too, when working full, the fire is started in the furnaces quite early in the morning. Operating an engine for driving machinery is also another use sometimes found for the steam from the waste-heat boiler. If no machinery is used, the steam can be utilized to operate an air compressor as practically every foundry which has two melting furnaces is equipped with a compressed-air system.

A third use is in heating core ovens. This can be done quite satisfactorily and although a slower process than drying cores at higher temperatures which can be attained with an oil or coal fire, the steam heat has the advantage that cores are never burned when it is used, as the temperature usually does not rise much above 250 degrees Fahr.

The accompanying illustration shows a row of steam-heated core ovens at the plant of the Dayton Malleable Iron Co., Dayton, O. This company has two of its melting furnaces equipped with waste-heat boilers and utilizes the steam, among other things, for heating some of its core ovens. Ten ovens, each with four compartments, are installed. The ovens are 16 feet wide, having four doors 4 x 6½ feet. These ovens, built by the Ohio Body & Blower Co., Cleveland, are 30 inches deep. Each of the eight racks is formed by eight 1-inch pipes running lengthwise in the oven and carrying approximately 80 pounds of steam. Gas burners, one of which is shown at *A*, are installed near the floor of the ovens, and gas is used at times in the summer to boost the temperature. As the company uses natural gas the shortage in winter precludes its use at that season.

The light cores used in the production of malleable-iron castings, as shown by the illustration, allow of a lower heat for drying than if heavier cores were required. The illustration also shows two types of trucks used in the core department. The truck at the extreme left is a barrow equipped with two motor-cycle wheels having the usual pneumatic tires. The tray for the cores is bolted at one end to the barrow, and the other end rests on two elliptical springs supported by



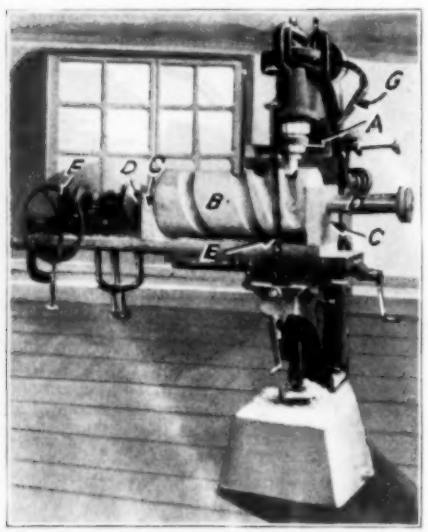
EIGHT 1-INCH STEAM PIPES CARRYING STEAM FROM THE WASTE-HEAT BOILERS FORM EACH OF THE EIGHT SHELVES IN THE CORE OVEN AND SUPPLY ENOUGH HEAT TO DRY THE CORES

the frame. The pneumatic tires and the elliptical springs minimize the jars which the cores receive in being trucked about the department. The second truck is made of a frame of angle iron set on four wheels. This supports, on four elliptical springs, a second frame with a channel iron, supported by two steel bars, bolted to each end. These channels extend below the frame of the truck and so control the end motion of the upper frame. Each is equipped with three malleable-iron castings so that bars may be laid from one end to the other. Four of these ⅝-inch bars form each of the three shelves for the cores. The truck is guided by four handles, two attached to each channel. The rear wheels are on fixed castors while the front wheels which are rubber tired are pivoted on the castors so that they may swing to guide the movement of the truck.

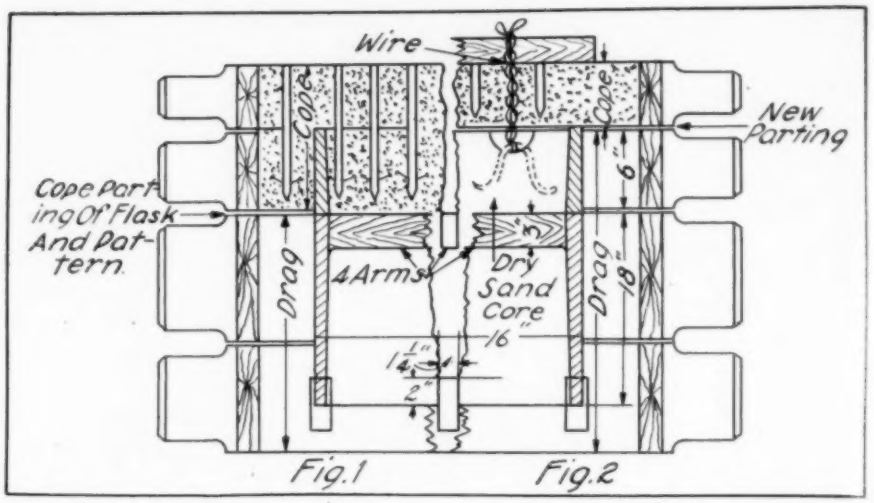
Adapting Metal Miller to Wood Pattern

By A. J. Tosco

Spiral grooves were cut in a wooden roll pattern by rigging a metal cutting milling machine in the manner shown in the accompanying illustration. The necessary high speed on the cutter was obtained by making a head *A* combining chuck, pulley and ball bearing seat. The ring containing the balls is located on the spindle which remains stationary. A speed of 2000 revolutions per minute was obtained by belting direct to the head *A*. The pattern *B* is a roll having two grooves of variable pitch and diameter. The pattern was turned in the lathe to the largest diameter. It then was placed in the jig *C* provided with bearings at *D D*. The pitch was laid off on the pattern. The depth was tested by the gage *E* and was determined by raising or lowering the table in the usual manner. The pattern was revolved as the work progressed by worm wheel and hand wheel *F*. Longitudinal in motion was obtained by advancing the table as in ordinary practice. The shavings were blown off by the air hose *G*. In this manner a long difficult job, if done by hand, was completed accurately in a comparatively short time.



A SPEED OF 2000 REVOLUTIONS PER MINUTE WAS SECURED ON THE CUTTING HEAD



THE USE OF A DRY SAND CORE ELIMINATED THE NECESSITY FOR EMPLOYING A SPECIAL COPE WITH CUT OUT BARS TO ACCOMMODATE THE RING

Dry Sand Cores Simplify Making the Mold

By M. E. Duggan

Many patternmakers are not as familiar with molding practice as they should be, this notwithstanding the fact that the pattern is not a merchantable product in the ordinary sense, but simply is a tool or device used in the production of a metal casting. Frequently the foundryman by a few simple changes converts an elaborate pattern involving special rigging into a plain job that can be handled in a routine manner and without any special adaptation either in flasks or rigging. The pattern and mold shown in the accompanying illustration furnish a fair example of this character. The drawing called for a hollow cylindrical casting provided at the lower end with four slots 1¼ x 2 inches and at a point 6 inches from the opposite end, with four arms each ¾ x 3 inches.

The patternmaker decided or assumed that the pattern would be molded on end in a green sand mold and to that end he made the pattern in two parts with line flush with the top side of the arms. The 6-inch ring above the parting line turned up separately and dowelled on to the lower half of the pattern. When the foundryman received the pattern he realized that he would have to cut the bars to accommodate the ring on every cope used on the job that day. This did not appeal to his practical mind and he adopted the expedient shown in the right hand half of the illustration.

The ring pattern was taken to the core room where a number of cores were made by the simple expedient of setting the ring on a plate, filling it with core sand and lifting it off after the sand was rammed flush with the top. Two bent rods were rammed up in each core by which to suspend it later in the cope. Instead of making a parting at the line indicated by the patternmaker, the entire pattern was rammed in the drag and the parting made at the top of the pattern as shown in the right hand half of the illustration. One of the prepared cores was filed slightly around the outside to make an *easy fit* and then was dropped into place inside the ring. A length of twisted wire attached to each hook was employed to fasten the core to the bars of the cope. In this manner a plain flat cope served the purpose and the hanging body of dry sand was an insurance that there be no *drops* to spoil the casting.

Appointed Manager

H. F. Hoevel has been appointed manager of the sand blast department of the J. W. Paxson Co., Nicetown avenue, Philadelphia. Mr. Hoevel has developed a new line of sand-blast machines.

The Detroit Stoker Co., Detroit, Mich., has purchased the plant of the Van Blerch Motor Co., Monroe, Mich., to which point it will remove the Detroit plant and general offices. The present foundry, located in Toledo, eventually will be moved to Monroe. The Detroit Foundry Co. will take over the Detroit premises of the Stoker Co., when vacated, and proceed to enlarge the foundry capacity.

UNITS OF CALORIFIC VALUE

By Robert J. Anderson

Calorific power of a fuel is the quantity of heat evolved by burning a unit weight of the fuel with oxygen. The calorific value of a fuel may be expressed in several units, but although interpreted in different units, the quantity of heat evolved in all cases is the same. The basis of these several units is the amount of heat required to raise a given quantity of water through a heat degree expressed either in Centigrade or Fahrenheit scales. The heat units which are used are the following:

Large calorie—The amount of heat required to raise one kilogram of pure water 1 degree Cent., the water being at 4 degrees Cent.

Small calorie—The amount of heat required to raise one gram of pure water 1 degree Cent., the water being at 4 degrees Cent.

British thermal unit—The amount of heat required to raise one pound of pure water 1 degree Fahr., the water being at 39.1 degrees Fahr.

Pound calorie—The amount of heat required to raise one pound of pure water 1 degree Cent., the water being at 4 degrees Cent.

The relations which exist between the different units are:

1 large calorie = 3.96832 B.t.u.

1 B.t.u. = 0.251996 large calories.

1 large calorie = 1000 small calories.

1 pound calorie = 2.2046 B.t.u.

1 pound calorie = 0.453592 large calories.

One set of units may be readily converted to another, and an example will indicate the method. Thus, to convert large calories per kilogram into B.t.u. per pound, the conversion factor is 1.8. This follows since 1 kilogram = 2.2046 pounds; and 1 large calorie = 3.96832 B.t.u. Hence,

$$\frac{3.96832}{2.2046} = 1.8$$

Published by permission of the director, United States bureau of mines.

HEAT REQUIRED TO MELT AND SUPERHEAT ALUMINUM

By Robert J. Anderson

The amount of heat required to melt and also to superheat aluminum is shown by the following equations. If it is desired to determine the amount of heat required to melt aluminum, the general equation

$$W = t \times Sm\ (0—t) + R$$

may be used, where

W = total heat required in gram calories,
t = melting point in degrees Cent. from zero,
Sm (0—t) = mean specific heat between 0 degrees Cent. and t degrees Cent., and
R = latent heat of fusion in gram calories.

Then using the following values for substantially pure aluminum,

t = 658.7 degrees Cent.,
Sm (0—t) = 0.2220 + 0.00005t, and
R = 76.8

and substituting in the formula,

$$W = 658.7 \times (0.2220 + 0.00005 \times 658.7) + 76.8$$
$$= 244.7$$

calories per gram to raise aluminum from zero to the melting point.

Since aluminum is normally at about 25 degrees Cent. (room temperature) when charged, the amount of heat actually required will be slightly less. The calculations, altered to conform to this condition, explain incidentally the saving of heat which will result in charging a hot furnace at night with cold metal thereby allowing absorption of heat. In the morning when the furnace is started, less fuel will be required to melt the charge than would be the case if the furnace were allowed to stand empty over night.

To find the amount of heat required to raise aluminum from any temperature to the melting point, the usual calculation may be made. If it is required to find the amount of heat necessary to raise aluminum from 25 degrees Cent. to the melting point, then

$$W = 658.7 \times [0.2220 + 0.00005\ (633.7)] + 76.8$$
$$= 243.9$$

calories per gram.

If the metal were at a higher initial-charging temperature, less calories will be required.

The B.t.u. per pound of aluminum may be obtained from the following formula: 243.9 x 1.8 = 439 B.t.u. per pound. This is equivalent to 43,900 B.t.u. per hundred weight or 878,000 B.t.u. per short ton.

(*Continued on Data Sheet No.* 445)

THE FOUNDRY DATA SHEET, SEPTEMBER 1, 1922
Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections 5x7 inches, and may be readily bound in note book form.

Correcting Flaws in Metal Mixtures

Problems of the Gray Iron, Malleable and Steel Foundry Discussed

By H. E. Diller

First Iron Comes Cold

Question: We are having trouble securing hot iron at the first of the heat although the iron after the first two or three taps is hot enough. The fan is only a few feet from the cupola, but delivers the correct amount of air as measured by a blastmeter. Metal starts to run through the tap hole 8 minutes after the blast is put on. The pigs weigh between 40 and 50 pounds. Could that cause the trouble, or is the fan too near the cupola?

Answer: The main thing that probably is wrong with your melting practice is that you do not light up your cupola long enough before starting the blast. The wood and a portion of coke charge should be lighted at least two hours before the blast is put on. Then after the blue flame comes through the coke, the remainder of the coke bed should be added and charging should not be started until a heavy blue flame again shows above the coke bed. The walls and bottom of your cupola will then be well heated before the melt is started and will not tend to lower the temperature of the iron.

Your pigs are a little large but this would not make any serious difference. The fact that the iron commences to run in eight minutes shows that you have the minimum amount of coke on the bed and possibly a little more coke on the bed would be of some assistance in giving you a hot iron at the start. The amount of blast required is governed by the amount of melted metal per hour, 30,000 cubic feet of air being required per ton of iron melted. If this amount of air is delivered the distance the fan is from the cupola will make no difference in melting.

Aluminum Softens Iron

Question—I would like to know the results which are produced when aluminum is added to gray iron, and also the amount which should be added per hundred pounds of iron.

Answer— When aluminum is added to a ladle of gray iron, it increases the tendency of the graphite to separate out as the metal cools, thus giving a casting with lower combined carbon. Varying amounts are used, as low as ½ ounce to 100 pounds of iron being used effectively. The effect will also be dependent somewhat upon the amount of silicon in the iron and whether the iron is oxidized or not. A high-silicon iron free from oxidation will be less affected by the aluminum than a low-silicon iron, or one which has been highly oxidized. A few experiments starting with the addition of ½ ounce to 100 pounds of iron and increasing this amount, will soon indicate how much the metal needs to secure the desired effect. One disadvantage from the use of aluminum is that it forms an oxide which does not readily rise to the surface but tends to form in patches in the casting.

Composition and Use of Washed Metal

Question—What is the composition of washed metal and for what purpose is it used?

Answer—Washed metal is an iron with approximately 4.00 per cent carbon and low sulphur, phosphorus and manganese. It is used by some steel manufacturers, especially by those making tool steel, to increase the amount of carbon in the bath. Its use is not as extensive as formerly because many steel makers now use a low-phosphorus pig iron in place of the wash metal.

Banking the Cupola

Question—Will you please tell us how to proceed to melt 60 tons of gray iron in one stack, melting 35 tons in the morning, allowing the cupola to lay dormant for from 1 to 2 hours and melting the remainder of the iron in the afternoon. We have tried doing this but found difficulty in opening the tap hole when starting the afternoon heat, on account of the slag freezing over the plug. Would is be more economical to use a 60-inch or a 72-inch cupola?

Answer—You should add three normal charges of coke between the two melts, then if it takes more than 10 minutes to bring down the iron after the blast is put on the second time, the amount of coke could be decreased on the next day. In this way you could gradually work down until you got the minimum amount of coke necessary. Leave the tap hole open after the morning heat and do not use any blast between the morning and afternoon heat. The 60-inch cupola (if you mean by this, lined to 60 inches) would be more economical than the 72-inch cupola for this work, and would probably give you the metal more nearly as you want it, as you should melt 12 to 14 tons an hour in the 60-inch cupola, while the 72-inch cupola would melt as much as 21 tons an hour.

Melting Tin Plate Scrap in the Cupola

Question—How can I melt tinplate scrap in the cupola? I have tried to do this but do not get out much but slag. I want to use the product for sash weights.

Answer—Light tin plate clippings can best be melted in the cupola if they are first compressed into a compact mass by using the busheling machine. They should then be placed in boxes or sheet iron pipe such as stove pipe and the ends of the pipe turned over. The object is to keep the oxidizing flame away from the fine pieces of clippings until they have fused into a more or less solid mass. However, no firms, so far as we know, use such material without the addition of other scrap and some pig iron.

Semisteel Not a Guarantee of Quality

Question: We are operating a gray-iron foundry and recently have had some calls for semisteel. As we have never made any semisteel castings we would like to know how much steel must be added to the charge to produce semisteel.

Answer: The word semisteel means that an indefinite amount of steel has been added to the mixture, and you would be complying with the requirements of the term if you added only a few per cent of steel to your charge. The term in no way guarantees the quality of the resulting metal. As far as the purchaser is concerned he should not be interested in whether steel has been added to the mixture or not. If he wants a definite quality of metal he should specify it in a minimum tensile strength, or transverse strength and deflection, and possibly a hardness test. Then if the addition of steel to the mixture is necessary to secure these properties the foundryman can add it. Generally 10 to 30 per cent of steel is used in the mixture to produce a good grade of semisteel. A tensile strength of 30,000 pounds per square inch can be obtained easily from a metal made from a mixture containing 15 per cent steel.

Preventable Variation in Weight

On 42 Machinery Castings It Was Found that 10.8 Per Cent of the Weight Could Be Saved by Devoting More Attention To the Various Steps in Their Production

BY JOHN D. WISE

ON FIRST thought it might appear that all castings made in the same manner from the the same pattern necessarily must be of the same weight, but observation of the weights of various castings made from the same pattern under identical conditions has disclosed surprising variations. The purchaser of castings makes a peculiar concession to the foundryman. In his dealings with all other persons from whom he buys, he must know in advance the amount of the invoice which will be rendered. For instance, when he orders steel or bolts, he is able to calculate to a nicety the amount he will have to pay for them. But to the foundryman he gives a more or less blanket order for a number of castings the weights of which generally do not correspond with those of previous shipments. The purchaser of castings realizes that the casting of minimum weight which he accepts serves its purpose as well or better than those of greater weight. Any excess weight is an extra expense to him. Therefore the user should be greatly interested in any study which will work toward the goal of standardization of the weights of castings.

Frequently the machine shop purchases the casting and in this way has a direct interest in excess weight. Three other considerations enter into its problem in dealing with the overweight castings. First and most important is the removal of the surplus metal present on the surfaces to be finished. It is not uncommon to find ¾ inch of stock where ¼ inch would be sufficient to remove the skin and to clean up minor surface defects. The relative amount of metal on finish pads and on portions where machining is not necessary will be covered later.

Handling Problem Is Affected

The second concern of the machine shop is the handling of overweight castings. In most cases the addition of 10 per cent to the weight of a given casting will not change it from a hand lifted weight to a crane-requiring weight or from one crane to another of larger capacity, but this will happen in certain cases and is, of course, an avoidable loss. The human factor enters here also since the work of handling castings by hand is materially lesened when the weight of the castings handled is decreased an average of 5 to 10 per cent. A decrease in weight reduces fatigue and increases efficiency.

The third concern of the machine shop in connection with overweight castings is in the use of jigs or fixtures. Since overweight takes the form of excess metal on the outside of the casting it follows that this excess metal interferes with jigs and fixtures, causing either a loss of time for adjustment or rejection of the casting. The rapidly increasing use of jigs makes this factor one of prime importance.

Standardized Weight

Foundrymen should be deeply interested in the standardization of weights of castings and in the reduction of standardized weight to a minimum. By decreasing the weight of all the castings produced from one pattern to the minimum weight necessary to meet specifications, the foundryman will decrease the amount of money which he receives, since his invoice is rendered on a per pound basis. This result might appear to be to his disadvantage and cannot be explained away by assuming that the decreased amount of iron melted and handled will show a saving that will offset the loss of the revenue from the excess weight. The real solution for the foundryman consists in a moral interpretation of his duties toward his customers—a policy or rendering the maximum service for each dollar charged. He constantly should endeavor to keep the weight of the casting down to the minimum.

Ultimately the foundryman who seeks to build up his business on the principle of furnishing minimum weight castings will outdistance competitors who cannot render the same service. Also he will be able to meet the competition of the manufacturers of forgings and pressed steel parts, both of whom may be able to replace a casting by a member of less weight and greater uniformity and frequently at a less cost per piece. This competition presents a definite challenge to the foundry industry to meet the quality as well as the price of these products. Surely any steps leading to the standardization and reduction of casting weights are in the right direction when considering the broadest interests of the foundry industry.

Fig. 1 presents the result of a comparison of the weights of castings made from the same pattern or from patterns slightly altered to reduce the weight, maintaining in every case, however, the same requirements for the finished castings. Each horizontal line contains a record of the castings made from one pattern when hand molded and later when machine molded. The weights given in columns 3 and 4 are average weights of a number of castings. Column 5 shows the weight reduction in per cent; columns 6, 7, 8 and 9 show the weight reduction in pounds per casting, the number required, the price per pound, and lastly, the value of the saving for the quantity considered. The average weight reduction of 10.8 per cent indicates that a study of the reasons for the saving will produce important results since the saving is large enough to be of considerable importance. In considering the problem of weight reduction it will be convenient to set forth the successive steps in the making of a mold, assuming ordinary side floor work of moderate size. Beginning with the blueprint the steps in the making of a casting are as follows:

Amount of finished metal to be allowed; method of molding; amount of draft; make the pattern; ram the mold; rap the pattern; draw the pattern; slick the mold; patch the mold; close and pour.

Part of Logical Plan

It will be noticed that the first three of the most important steps leading to the producing of a casting from a blueprint are performed in the pattern shop before the pattern is made. In too many cases the patternmaker decides these important factors without conferring with the foundry and machine departments. In so doing he influences to a large degree the subsequent methods these departments must employ and to a large degree the amount of unnecessary work to which they may be subjected.

From a paper presented at the Rochester convention of the American Foundrymen's association. The author was foundry superintendent University of Illinois, Urbana, Ill., and now is connected with the engineering department Osborn Mfg. Co., Cleveland.

Obviously a more logical plan should be adopted at the start and carried throughout all the operations occuring between the blueprint and the finished casting. No single operation should be considered as a separate unit but each should be considered as a part of one logical plan.

The first factor, *deciding upon the amount of finish metal necessary*, usually is settled by the patternmaker in accordance with the following general rule: It always is possible to machine off surplus metal while none can be added. He thus adds a safe amount of metal to allow for the unpredictable come and go of the casting. If it were known that the castings would be uniform in size it would be possible to allow only enough finish metal to require the removal of the skin and its attendant surface imperfections. All foundrymen are familiar with the fact that hand molding cannot produce this uniformity; but most of them are aware of the fact that machine molded castings possess uniformity of size and weight. It is a matter of general experience in the automotive and other industries that machine molding produces castings of uniform size.

The second factor, *deciding upon the method of molding*, consists chiefly in the location of the parting line which seriously affects the production of the casting, but usually does not exert any effect on the weight.

The third factor, *deciding upon the amount of draft necessary* affects the weight to a large degree. Again the patternmaker generally decides this question without conferring with the foundryman who must use the pattern. He works upon the principle that too much draft will not harm the pattern while too little will cause excessive breaking of the mold and will cause the pattern to be returned for alterations. He therefore allows liberal draft, a part of which is necessary and a part of which is superfluous. This excessive draft adds a constant and unnecessary weight of metal to the finished casting. Draft is necessary primarily in hand molding since it is impossible to draw the pattern straight upward from the sand by hand. Theoretically a pattern drawn vertically need have no draft. This action is closely approximated by molding machines which are much more accurate than a human hand can be.

The fourth factor, *making the pattern*, has far reaching and interesting effects upon many other problems having to do with the cost of the casting but not on the item of weight. *Ramming the sand around the pattern* in the foundry introduces variable elements which greatly affect the weight. The ideal condition desired in ramming is that the sand shall be of the maximum density and yet allow proper venting; and second, that it shall be of exactly uniform density over the entire surface of the pattern. The skilled molder approaches, only in a rough way, the ideal condition. Obviously he cannot produce a mold of exactly even density with the result that the equal liquid pressure of the metal forces back the sand at the soft portions and produces at these points swells on the casting, all of which are unnecessary and add preventable weight. The maximum density of sand is never obtained, for the molder leaves a large margin of safety to be certain of avoiding trouble due to lack of venting in the sand. Obviously this factor cannot entirely be eliminated but it can be reduced to a negligible quantity. The molding machine, with its constant uniformity from the beginning to the end of the day and from day to day, can produce exact uniformity on the entire surface of the mold and can approach the maximum uniform density much more closely than the molder attempting it by hand.

The sixth factor, *rapping the pattern*, is an operation introduced by the molder for the purpose of enlarging the mold that the pattern may be withdrawn with the least possible amount of damage to the mold. Rapping accomplishes this purpose but it also enlarges the cavity so that overweight is introduced into the casting. When considering the weight of the casting with a view of reducing it to a minimum, it is readily apparent that if rapping is eliminated entirely the reduction in weight sought for will be obtained. By omitting rapping, however, the molder invariably would make matters worse by introducing excessive patching of the mold. Therefore he is forced to choose rapping as the lesser of the two evils. The molding machine will

1 Castings Number	2 Castings Name	3 Weight When Hand Molded	4 Weight When Mach. Molded	5 Reduction-% 3 - 4 3 x 100	6 Saving Per Csg. in lbs. 3 - 4	7 No. RQD	8 Rate Per Lb. ¢	9 Total $ Saved 6 x 7 x 8
C-5R	Truck	38.6	33.3	13.7	5.3	220	6¼	75.79
D-6	Base	34.0	312.	8.2	28.	15	6½	27.30
C-42A	Draw cyl cover	49.6	45.	9.3	4.6	10	6¼	2.87
B-74	Sand guard	24.	23.	4.1	1.	20	6¼	1.25
C-77	Squaring shaft	65.	58.	10.7	7.	10	9	6.30
D-78	Frame	340.	300.	11.7	40.	10	9	36.00
D-79A	Leveling table	121.	112.	7.4	9.	10	9	8.10
D-80-A	Base	264.	200.	24.2	64.	35	6½	145.60
C-201-A	R. O. Bracket	50.	38.	24.	12.	5	9	5.40
C-202-A	R. O. Bracket	58.	38.	34.5	20.	5	9	9.00
C-227	Sand guard cover	123.	110.	10.6	13.	1	6¼	.81
B-308	Safety st. collar	2.5	1.85	30.	.65	45	6½	1.90
B-310	Insp. hole cover	6.2	5.5	11.3	.7	10	6¼	.44
B-430	Leveling levers	4.3	4.	7.	.3	30	9	.81
B-431	Leveling levers	5.3	3.3	37.7	2.	30	9	5.40
B-549	Cylinder head	79.	60.	24.	19.	15	6¼	17.81
A-1500	Muffler section	3.4	3.	11.7	.4	100	7	2.80
C-1500	Muffler section	3.6	3.2	11.1	.4	150	7	4.20
C-2541	Wheel	38.	37.4	1.5	.6	100	6½	3.90
A-2599	Base	324.	311.	4.	13.	10	9	11.70
B-2638	Crank hub	4.1	4.1	0	0			
C-2651	Crank disc	12.4	9.6	22.6	2.8	20	9	5.04
C-2768	Bracket	2.	1.3	35.	.7	40	9	2.52
B-3360	Cylinder head	55.	54.8	36.	.2	10	6¼	.12
A-5018	Jolt table	268.	249.	7.1	19.	10	6½	12.35
A-5732	Draw piston	116.	113.	2.6	3.	1	6¼	.19
A-5872	Base top cover	12.	11.	8.3	1.	20	6½	1.30
A-7591	Muffler	2.	1.8	10.	.2	40	7	.56
A-7745	Car frame	71.	56.	21.2	15.	20	6½	19.50
B-7745	Car frame	66.	54.	18.2	12.	20	6½	15.60
A-7864	Base	282.	225.	20.2	57.	60	6½	222.30
A-7879	Shield	33.	29.	12.1	4.	60	6½	15.60
A-7883	Wheel	27.2	24.3	10.6	2.9	500	6½	94.25
A-7982	Pressure hd. stop	12.3	12.	24.	.3	35	6½	.68
A-8331	R. O. Trunion	66.	64.	3.	2.	20	6¼	2.50
B-8331	R. O. Trunion	68.8	63.3	8.	5.5	20	6¼	6.87
A-8405	Jolt piston	527	475.	9.9	52.	10	6¼	32.50
A-8415	Housing bushing	248	246.	.8	2.	10	6¼	1.25
A-8792	Jolt piston	330.	316.	4.2	14.	15	6¼	13.12
D-8929	Leveling car	516.	480.	6.6	36.	15	6¼	33.75
C-8931	Draw cylinder	722.	535.	26.	187.	15	6¼	175.31
C-8934	Housing bushing	422.	415.	1.6	7.	15	6¼	6.56
TOTALS		5802.3	5137.75		664.55	1787		
AVERAGES		138.1	122.3	10.8	15.8	4.25		
TOTAL SAVING								$1029.25

FIG. 1—TABLE SHOWING COMPARISON OF WEIGHTS OF CASTINGS

draw the pattern vertically upward from the mold, loosening it from the clinging action of the sand by means of air or electrically operated vibrator which does not appreciably enlarge the cavity. In this way the rapping of the pattern can be eliminated with a resultant saving in weight.

The eigth and ninth factors, *slicking* and *patching the mold*, are in reality repair operations to overcome the damage done to the mold by the withdrawal of pattern. Both of these operations should be eliminated but this is not possible when the pattern is drawn by hand. Molding machines draw the pattern so accurately that no slicking and patching are necessary.

The tenth factor, *closing and pouring the mold*, introduces little or no variation in the weight, unless the density of the iron is affected slightly by the height of pouring head or by such special methods as the rotation of molds, while being poured.

By dividing the 10 operations given on page 7 into two groups, first, those performed in the pattern shop, and second, those performed in the foundry, it is apparent that the problem is a common one for the foundry, machine shop, and the pattern shop to solve before work on the pattern is started. If each of these departments is to perform its particular portion of the work in the least time and at minimum cost the operation must be planned jointly from beginning to end by those who are responsible for its execution.

Variable and Constant Factors

To more intelligently attack the general problems of casting overweight the operations causing it may be divided into two classes; First, those causing variable amounts of overweight, and second, those causing constant amounts of overweight.

The operations causing variable excess weight are:

Nonuniform ramming of the mold; rapping of the pattern; drawing of the pattern obliquely; slicking and patching the mold.

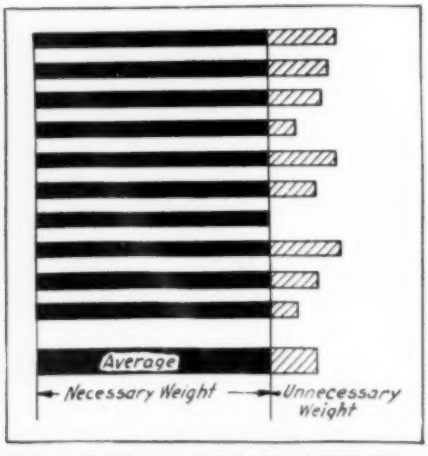


FIG. 2—TYPICAL CONDITION EXISTING IN CASTINGS MOLDED BY HAND FROM ONE PATTERN

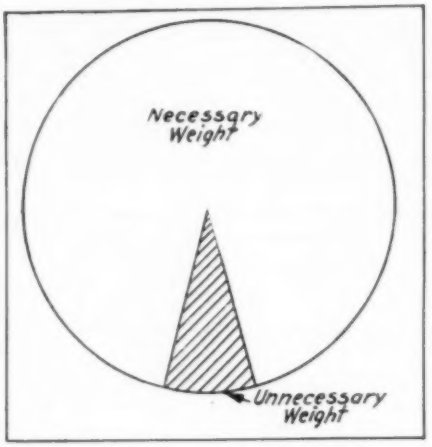


FIG. 3—GRAPHIC REPRESENTATION OF 10 PER CENT REDUCTION OF WEIGHT SHOWN IN FIG. 1

The operations causing constant excess weight are:

Too much finish metal; too much draft.

It is important to know definitely which of these factors adds the most excess weight to the casting so that we may know their relative importance and treat them accordingly.

No comprehensive study has been made of the importance of these different operations and therefore no definite answer can be given here. However, it might be well to indicate some of the factors which will assign to these different operations their positions of relative importance. Excessive finish allowance metal exists on the parts which are to be machined and consequently, on a casting which is to be machined all over, this extra metal may take the shape of an extra ¼ inch, more or less, added to the entire surface of the casting. Its percentage to the total weight varies with the shape of the casting. It would be minimum on a spherical casting and maximum on a thin, flat casting of large area, and reach the maximum on a casting which is machined all over. Excess metal allowed for finish may be the most important factor in overweight or it may be of the smallest considerations, depending entirely upon the shape of the casting.

Excessive draft similarly is variable. It is not necessary to use any draft on a spherical pattern parted on the diameter and it follows that such a casting would not carry any extra metal on account of draft. A cubical block necessarily would have draft on four of its six sides and the excess metal in such a case would be relatively heavy. A casting deep in proportion to its area will have on it a maximum of excess metal due to draft allowance.

Swells on the castings are of two kinds. The first is an enlarging of the entire casting caused by the giving of the sand as the liquid pressure of the metal is exerted upon it. This is uniform over the entire surface and in amount is inversely in proportion to the density of the sand. The second class of swells are confined to a small portion of the casting surface caused by light ramming at that particular point. These may be so slight as to be almost imperceptible on castings made by an experienced molder and may assume such proportions as to be highly objectionable on castings made by unskilled men. However, as previously mentioned, both are entirely eliminatd in machine molding.

Rapping the pattern usually is performed backward and forward and from right to left but seldom by driving the pattern into the sand. The casting is enlarged, therefore, rather uniformly on the sides but little, if any, on the top and bottom. The amount of enlargement depends upon the amount of rapping and this is determined by several things. A pattern of a shape difficult to draw usually is rapped more than one of easy drawing shape and an inexperienced molder finds it necessary to rap more strongly than the experienced molder. The use of air or electrically operated vibrators eliminates excess weight due to rapping.

The slicking process enlarges the mold uniformily, or approximately so, over the entire surface and affects different shapes of castings in the same manner that excess metal for finishing purposes affects them. The principal point to bear in mind in regard to slicking is that it is an entirely preventable evil, since by eliminating rapping and by drawing the pattern accurately it is not necessary. Patching is in much the same class as slicking, except that usually it is local in effect. When building up a broken portion of the mold the molder naturally puts extra metal on the casting rather than not leaving enough.

Fig. 1 presents that data gathered when 42 light machinery patterns were

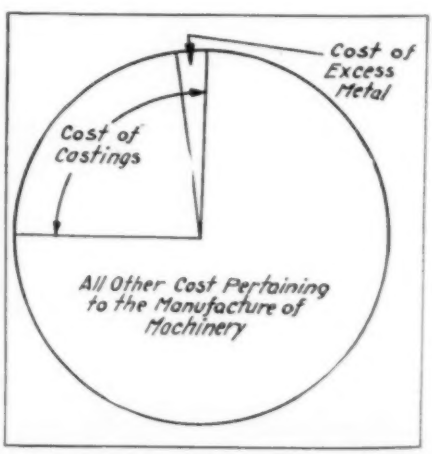


FIG. 4—COST OF EXCESS METAL SHOWN GRAPHICALLY

changed from hand to machine molding. Fig. 2 shows the typical condition existing in the case of the castings made from one pattern when hand molded. The outstanding feature is the erratic variation. When the 42 different cases considered in Fig. 1 the average reduction is 10.8 per cent in weight. This is shown graphically in Fig. 3. The effects of this reduction are far reaching. Castings are purchased by weight; therefore the cost of rough castings is decreased 10.8 per cent to the user.

Since the cost of castings is about 20 to 30 per cent of the gross cost of light machinery this means a saving of 2 1/5 to 3 1/5 per cent which is added directly to the profit of the manufacturer, as indicated in Fig. 4.

Nor is this all. Following the casting into the machine shop we find there several items that will result in distinct savings based on number of operations.

Less metal to be machined off; less layout work; castings may be handled more rapidly in jigs; less filing to be done on the rough surfaces.

No investigation has been made of the amount of saving effected by these changes in the machine shop but, whatever their magnitude, they decrease the cost of the finished casting and are a step in the right direction.

Analytical Methods for Iron and Steel

BY PAUL V. KLINE

THE following methods for the determination of phosphorus and manganese in iron and steel have been found by the author to be short and to give accurate results. The formation of the pure ammonium phosphomolybdate with a constant composition is possible only under certain closely controlled conditions. Therefore, it is necessary for a chemist to ascertain for himself by repeated experiments what these conditions are and to standardize the solutions and make the determinations under exactly the same conditions each time.

Weigh 1 gram of finely divided drillings and transfer them to a 100 cubic centimeter bates sugar flask and add about 50 cubic centimeters of dilute nitric (323 cubic centimeters of nitric to 1677 cubic centimeters of water). Set the flask on the hot plate and heat until the drillings are in solution and the brown fumes expelled. Set the flask aside or cool under the tap until it reaches room temperature. Then carefully dilute to mark and filter through a dry filter. Now pipette off 50 cubic centimeters of the filtrated filter into a 300 cubic centimeter erlenmeyer flask. This will represent 0.5 gram of the sample to be used for the phosphorus determination. Next pipette off 25 cubic centimeters of the filtrate into a 200 cubic centimeter beaker to be used for the manganese determination. This, of course, represents 0.25 gram of the sample.

Phosphorus—Set the flask containing the 50 cubic centimeter sample on the hot plate and allow the solution to come to a boil. Then add enough potassium permanganate solution (10 grams of potassium permanganate per 100 cubic centimeters of water) until a chocolate precipitate is formed. It usually takes about 2 cubic centimeters of the permanganate solution to do this. Now destroy the brownish precipitate with a ferrous sulphate solution (50 grams of ferrous sulphate in 500 cubic centimeters of water and a few drops of sulphuric acid). A few drops of this solution is all that is necessary and gives the solution in the erlenmeyer flask a greenish cast. Bring the solution to the temperature of the hand and add 15 to 20 cubic centimeters of ammonium-molybdate solution (130 grams of molybdic acid thoroughly mixed with 284 cubic centimeters of distilled water and 286 cubic centimeters of ammonium hydroxide, specific gravity 0.90, added when solution is complete. This is poured with constant stirring into a mixture of 670 cubic centimeters of nitric acid and 760-cubic centimeters of water). Shake vigorously to bring down the yellow precipitate. Allow the yellow precipitate to settle only a few minutes otherwise it will stick to the sides of the flask making it difficult to wash onto the filter paper. Carefully filter and wash with 1 per cent potassium nitrate solution until the flask and paper are free of acid. Transfer the paper into the original erlenmeyer flask add 25 cubic centimeters of water and a few drops of phenolphtalene indicator and a measured excess of N/10 sodium hydroxide solution. Insert the stopper and shake vigorously until the yellow precipitate is dissolved, remove the stopper and wash the stopper and sides of the flask with distilled water. Titrate with N/10 nitric acid. Titrate the acid and the alkali against each other and also against a standard sample.

The calculation of results is as follows:

W=Weight of phosphorus in 0.5 grams of standard sample used.

A=The cubic centimeters of alkali used.

B=The cubic centimeters of acid used to back the titrate.

R=The ratio between the alkali and acid as found by titrating one against the other.

$$R = \frac{\text{c.c. of alkali}}{\text{c.c. of acid}}$$

$$\text{Amount of phosphorus per cubic centimeter of N/10 alkali} = \frac{W}{A - B \times R}$$

Amount of phosphorus in any sample =(A—B×R)×(amount of phosphorus per cubic centimeter N/10 alkali)×2.

On low phosphorus determinations greater accuracy is obtained by using acid and alkali titrating solutions of N/20 strength.

Manganese—The 25 cubic centimeter portion is placed on the hot plate after adding 15 cubic centimeters of silver nitrate solution (5 grams of silver nitrate to a mixture of 400 cubic centimeters nitrc acid and 600 cubic centimeters of distilled water). Heat to incipient boiling. Then add 15 cubic centimeters of ammonium persulphate solution (140 grams of ammonium persulphate dissolved in 1000 cubic centimeters of water). Continue heating for a half minute after oxidation begins and bubbles arise freely. Set aside or cool under tap until it reaches room temperature. Titrate with standard sodium arsenite to the loss of the permanganate color. By adding 10 cubic centimeters of sodium chloride solution (5 grams of sodium chloride in 500 cubic centimeters of water) aids in obtaining a distinct end point.

To find a factor for the sodium arsenite solution calculate from the cubic centimeters necessary to destroy the pink color on a 0.25 gram sample of a standard iron or steel.

British Iron and Steel Institute To Meet

The autumn meeting of the British Iron and Steel institute will be held at York, Sept. 5 and 6, under the presidency of Francis Samuelson. The program includes the reading of 10 papers, and the members will be invited to a garden party in the grounds of the Yorkshire Philosophical society. Special trains will be run to Chesterfield to enable the visitors to tour the works of the Staveley Coal & Iron Co., and the works of the Parkgate Iron and Steel Co., Ltd., Rotherham also will be visited.

Unique Pipe Making Method

Several Ingenious Ideas and the Exercise of a Considerable Degree of Molding Skill on the Part of the Foundryman Saved the Expense of Making Complete Patterns

BY HENRY SALE

MANY men accustomed to miscellaneous jobbing shops probably have had similar experience in making large pipes in an emergency without a patter and therefore a description of methods employed may not appeal to such foundrymen but to others who have not had this experience the following outline will be of interest. The plan and section of a plain bend core are shown in Figs. 9 and 10. This bend is a true arc of a circle and therefore the two half cores were made on the same core plate and later matched by turning one half end for end before placing it on top of the other half. In the case of other pipes in the same lot, for instance the connection shown in Fig. 11, it would be necessary to either make two core plates, or to make one-half core on one side, then roll the plate over and make the other half core on the opposite sdie. A rough frame approximately 2 inches wider than the core on each side, was laid on a prepared bed and a cast-iron plate was made on which to sweep the core. The oven was too small to accommodate the core, therefore the plate was set up on three single-brick walls, as shown in the section Fig. 10. Instead of a cast-iron arbor, several lengths of old tubing were bent to serve as reinforcement. Three cast-iron plates with 1-inch nuts cast in to serve as anchors for the lifting bolts were placed in relation to the pipes as shown in the plan view Fig. 9. The sand was rammed in the usual manner with a generous quantity of coke in the interior of the core to facilitate the escape of the gas generated during pouring and then the proper shape was imparted to the half core by a sweep provided with a shoulder at one end, which engaged the edge of the plate all along one side. Suitable plugs rammed in the core and removed before the anchor plates were set insured a clear opening for the lifting bolts after the core was dried and rolled over. The plates and openings were arranged so that the lifting bolts could be inserted either from the top or from the joint side of the core. Usually the cope half of a core only is handled from the top side, but in this instance both halves of the core were used for patterns and were lifted from both sides. The drag half of the core was made first and dried on the plate in the position in which it was made, by building a fire under the plate and small supplementary fires over the top. After it was dried it was lifted off and the cope half of the core made and dried in the same manner.

A full size drawing of the pipe was made on a board as shown in Fig.

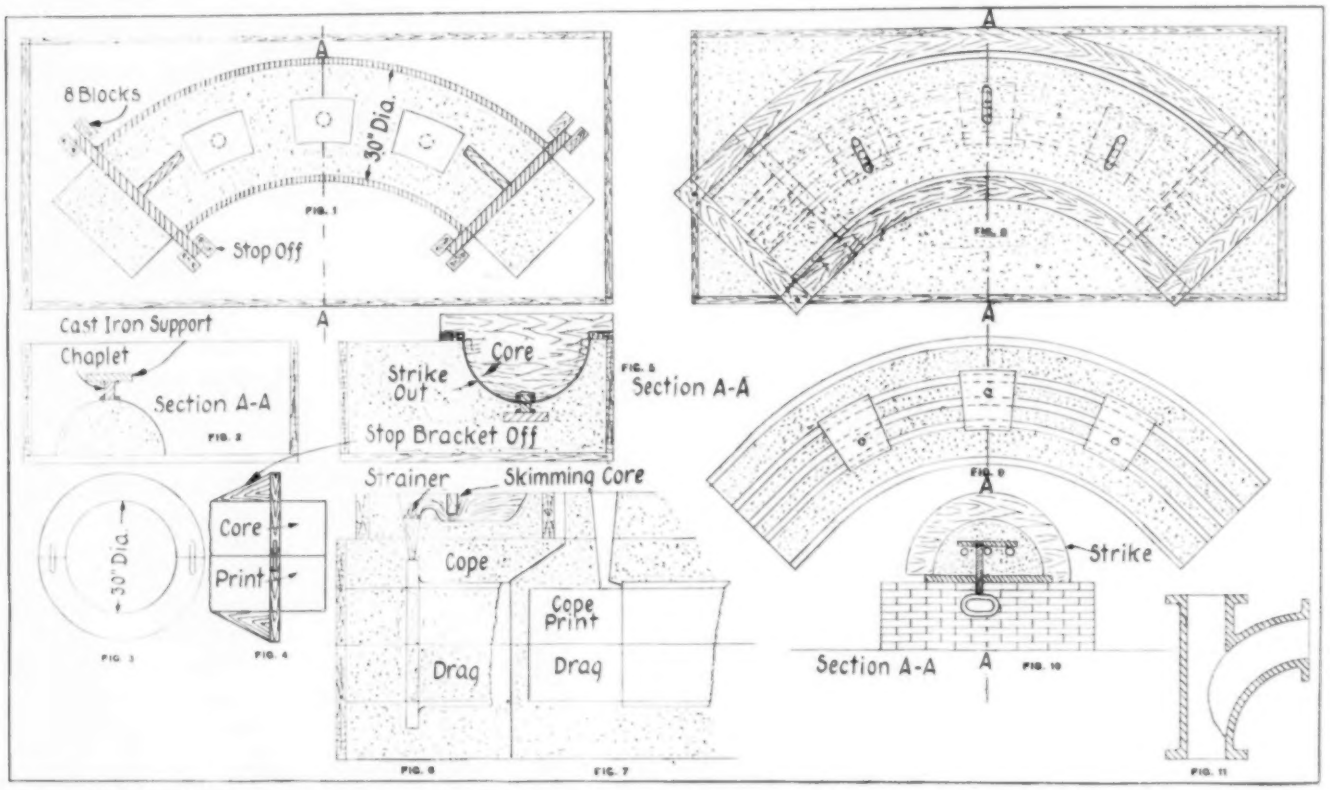


FIG. 1—A FULL-SIZE DRAWING ON THE ROLLOVER BOARD SERVED TO LOCATE THE DRAG HALF OF THE CORE FIG. 2—CHAPLET SUPPORT FIG. 3—HALF RING FLANGES FIG. 4—BRACKETS HELD THE FLANGES IN LINE FIG. 5—A THICKNESS OF SAND WAS CUT OUT CORRESPONDING TO THE METAL THICKNESS REQUIRED FIGS. 6 AND 7—RECOMMENDED METHOD OF POURING LARGE PIPES FIG. 8—THE FRAME FOR GUIDING THE SWEEP IS ATTACHED TO THE JOINT EDGE OF THE FLASK FIGS. 9 AND 10—PLAN AND SECTION OF CORE FIG. 11—SHAPE REQUIRING RIGHT AND LEFT HAND CORES

1, with the part representing the metal section lined for clearness. The drag half of the core was carefully adjusted on the board according to the lines on the drawing, and a half-ring flange was set in its proper position at each end and held there by small blocks nailed to the board and by a bracket on top. This bracket was attached to the flange and the cavity which it left in the sand was filled in during the process of finishing the mold. The drag was set on and rammed full of sand, suitable bearings in the shape of iron plates were rammed over each core print and over the center to support the chaplets.

After the drag was rolled over the cope half of the core was set in its proper position on the drag half, half-ring flanges were adjusted on each end and then the cope was rammed full of sand. Long eye bolts attached to the anchor plates in the core at one end and secured by suitable rods above the cope bars, served to bring the half core away at the same time the cope was lifted and rolled over. The bolts were released at the back and after the frame shown in Fig. 8, conforming to the outside shape of the casting, was attached temporarily to the joint edge of the flask, the core was lifted out. The flanges were not disturbed until after the strike shown in Fig. 5 had been employed to remove the thickness of sand corresponding to the required thickness of metal in the proposed pipe. The frame then was transferred to the drag half of the mold where the process was repeated.

We allowed ¼-inch finish on the face of the flanges and then added another ¼-inch to compensate for possible variation of the two half flanges from the straight line. A number of different shaped pipes were made to fill the particular contract, but they all were made after the same general manner.

Form Supply Company

Fasy & Hannas Co., 5315 North Second street, Philadelphia, has been organized by Joseph I. Fasy, who has withdrawn from the Liberty Supply Co., Inc., and John T. Hannas. Mr. Fasy has been identified with the foundry and supply trade as sales manager for the Philadelphia Chaplet & Mfg. Co., Inc., and until recently as vice president and sales manager of the Liberty company. Mr. Hannas was formerly secretary and treasurer of the Chestnut Street Engraving Co., Philadelphia. The new company has purchased from the Liberty company practically the entire stock of perforated tin chaplets, pressed tin and copper and crown chaplets, bench rammers, round point, square point and molders' shovels, picks, etc. The company will handle the chaplets and anchors manufactured by the Philadelphia Chaplet & Mfg. Co.

Sand Blast Company Opens Eastern Office

The Mott Sand Blast Mfg. Co., Chicago has opened eastern sales and engineering offices at 1402 Grand street, Hoboken, N. J. A complete stock of sand blast equipment, machines, and accessories will be kept to enable eastern customers to secure repair parts or additional equipment quickly. Construction and designing engineers at the new branch will co-operate with customers to secure the proper equipment.

Purchase Equipment

Johnston & Jennings Co., Addison Road, Cleveland, has purchased the business of the United States Molding Machine Co. of that city and will continue the manufacture and sale of the equipment which the latter firm formerly produced. The machines to be made will include two sizes of plain squeezers; two sizes of jar squeezers; two sizes of jar, squeeze, pattern-draw machines; two sizes of jar, squeezer, rollover, pattern-draw machines; five sizes of jar, rollover, pattern-draw machines; one type of plain jar, stripping-plate machine; and seven sizes of plain jar-ramming machines. This parallels the line formerly produced by the United States Molding Machine Co. In addition the Johnston & Jennings Co. proposes to make a smaller type jar, squeezer machine.

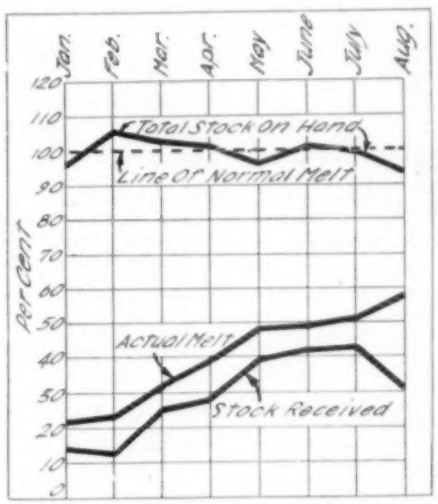
The Johnston & Jennings Co. is equipped to make these machines within its own shops. It has its own engineering department, pattern making shop, foundry and machine shop. N. S. Calhoun is president, T. J. Calhoun, vice president and J. C. Brainard is secretary of the company.

Frederic B. Stevens, Detroit, continues his agency for the molding machines under the new arrangement.

Strike Influence Felt by Ohio Foundries

While an increase in foundry operations in Ohio is evident from the reports prepared by Secretary A. J. Tuscany of the Ohio State Foundrymen's association, Cleveland, the blighting influence of the mine and railway strikes is clearly shown in the report on stocks of metal. As may be noted from accompanying curves, reserves have commenced to drop and the stock received during July fell off sharply. The 69 foundries reporting have a normal melt of 20,648 tons, while the actual output was 12,087 tons, giving 58.4 per cent as the ratio of the actual to the normal production.

In the curves shown, the actual melt is figured as a percentage of the normal melt, and the stocks of pig iron and scrap on hand and also those received during the month are compared to that same normal melt of the foundries reporting. During June, 68 shops reported a total of 7871 tons of pig iron purchased, while during the month just past, only 4972 tons were bought on contract or for spot delivery.



PRODUCTION INCREASES

The June total of scrap purchased was approximately 2200 tons, while during July 1549 tons were received by the 69 foundries noted.

Publish Technical Paper

The bureau of mines has issued a technical paper, "Inclusions In Aluminum-alloy Steel Castings," by Robert J. Anderson, metallurgist of the bureau. The paper states that in aluminum-alloy foundry parlance metallic and nonmetallic inclusions are termed "hard spots," and in aluminum-alloy sand castings and in die castings they are quite troublesome.

The inclusions differ so widely that the term *hard spots* is only roughly descriptive at best; in fact, the term is exceedingly undesirable, and should not be accepted in the nomenclature of metallography. However, because it has been in common usage for such a long time it is used in this paper to include all kinds of metallic and nonmetallic inclusions that cause difficulty in polishing and machining aluminum-alloy castings.

THE FOUNDRY

Registered U. S. Patent Office

A semimonthly journal devoted to all branches of the foundry trade

Published by
THE PENTON PUBLISHING CO., CLEVELAND

BRANCH OFFICES

BOSTON.....476 Old South Bldg.
CHICAGO.....1147 People's Gas Bldg.
CINCINNATI.....501-505 Commercial Tribune Bldg.
NEW YORK.....2203-2206 St. Paul Bldg.
PITTSBURGH.....2148-49 Oliver Bldg.
SAN FRANCISCO.....675 Monadnock Bldg.
WASHINGTON, D. C.....84 Home Life Bldg.

FOREIGN OFFICES

BIRMINGHAM, ENGLAND.....Prince's Chambers
LONDON, ENGLAND.2-3 Caxton House, Westminster, S.W. 1
PARIS, FRANCE.....224 Rue de Rivoli
Cable address, IROTRAPEN, London

SUBSCRIPTION

United States and Mexico.....$3.00 a year
Canada.....$4.00 a year
Great Britain and other Foreign Countries.....$4.00 a year
Single Copies.....25 cents
Copies published three months or more previous to date of current issue, 50 cents each.

ADVERTISING

All communications relating to advertising copy, discontinuances, etc., must be received on the 1st and 15th of the month preceding date of publication.

Member, the Audit Bureau of Circulations, Associated Business Papers, Inc., and National Publishers Association

Entered at the Post Office at Cleveland as Second Class Matter

Copyright 1922 by The Penton Publishing Co.

Contents

	Page
Set Core Mixture Standards	695
Used Loam and Green Sand	701
Annealing Prolongs Life of Ingot Molds	703
Operates Warning Signal if Feed Stops	703
Opens a New Foundry	703
Graphite Structure Revealed	704
Making Flanged Hub on Jolt Machine	706
Bricks for Malleable Furnaces	707
Builds Canadian Plant	710
Making Red Brass Castings	711
How and Why in Brass Founding	714
Aluminum Becomes Hard Through Remelting	714
Bronze Bearings May Be Poured Too Hot	714
Clean Castings Poured On An Incline	715
Crucible Not Suitable Melting Medium	715
Moisture Condenses on Small Steel Wires	715
Plates Are Discolored	715
Bill Discusses Pulley Molding Problems—III	716
Utilizing Steam From Waste-Heat Boilers	719
Adapting Metal Miller To Wood Pattern	720
Dry Sand Cores Simplify Making the Mold	720
Appointed Manager	720
Correcting Flaws in Metal Mixtures	721
First Iron Comes Cold	721
Aluminum Softens Iron	721
Composition and Use of Washed Metal	721
Banking the Cupola	721
Melting Tin Plate Scrap in the Cupola	721
Semisteel Not a Guarantee of Quality	721
Preventable Variation in Weight	722
Analytical Methods in Iron and Steel	725
British Iron and Steel Institute to Meet	725
Unique Pipe Making Methods	726
Form Supply Company	727
Strike Influence Felt by Ohio Foundries	727
Sandblast Company Opens Eastern Office	727
Purchase Equipment	727
Publish Technical Paper	727
Safety Education Still Needed	728
Why Cut Prices on Castings	728
Trade Outlook in the Foundry Industry	729
Personal	730
French Foundrymen Seek International Meeting	730
Electrochemists To Meet in Montreal	730
Siphonage Applied To Shop Ventilation	730
Discontinues Converter	730
August Sales Sustain Interest	731
What the Foundries Are Doing	732
Trade Publications	732

Safety Education Still Needed

HUMAN conservation, through safety work, has been in progress less than a generation. Started in industrial lines, the idea of education along safety lines has spread, being fostered by public service agencies, magazines, newspapers, schools, banks and in fact every active working agency where opportunity has offered. In foundries, the benefit has been marked. Improvement in lighting and ventilating, guarding dangerous moving machinery, protection of eyesight in grinding and chipping operations, safe clothing and shoes for those who carry metal, and all the thousand and one different conditions under which the modern foundrymen work bear witness to the value of this educational work. It seems inconceivable, with all the activity in safety lines during the past few years, that any individual workman could have missed the lessons set before him. Yet, only a few weeks ago a decision rendered in an eastern court held that a workman losing his eyesight through failure to wear goggles provided by his company, could not recover damages. Further, one user of a widely known hand squeezer molding machine told the manufacturer of this machine that he did not wish to install power squeezers, made by the same firm, because of the added jeopardy. He said that with the handpower machine, the workman must employ both hands to squeeze the mold; while with the compressed air squeezer, he might leave one hand on the table or under the flask and be injured. The latter might seem far-fetched, but it demonstrates that enlightenment is not complete. Aside from the humanitarian aspects of safety education, the real need for man power within a short time will demonstrate the economic value of human conservation.

Why Cut Prices on Castings?

RECENTLY a former purchasing agent for a manufacturing concern which buys a large tonnage of castings every year, remarked that he considered foundrymen the easiest class in the world from which to buy. He said that when he had a casting job to let he knew in advance that he could get the foundryman to shade his first price whatever it might be. In fact, at times the seller without waiting for the suggestion that the price was too high would read in the purchasing agents expression some hint of doubt and would reach for his pencil to refigure his bid. Perhaps, this buyer's impression was gained through associations when times were lean and castings contracts scarce. Perhaps, too, he might find that conditions have changed and that foundrymen now know how to figure their costs and have an honest belief in the correctness of the calculations upon which they base their prices. Price cutting always is more prevalent during dull times, when a buyers' market prevails and every available job is snatched eagerly to help carry the foundry overhead. Also, on a falling market, one may expect to find price cutting; but what excuse exists for such practices during the present times? Material prices are advancing. A labor shortage is threatened. Demand for castings is increasing. Every indication points to the fact that this is a sellers' market and therefore the maker of castings is not so eager. With these factors in mind, why should any foundryman seek to shave his own honestly compiled prices to meet real or imagined competition?

Trade Outlook in the Foundry Industry

NORMAL mid-summer slackening in foundry operations has been strangely absent this year. Where July and August usually mark the low ebb in castings manufacture, a steady appreciation in orders has been noted. Dearth of stocks among manufacturers who are large users of castings, the continued unprecedented demand for automobiles, improvement in the implement trade, abnormal building and public works construction and railway buying all have contributed to make this condition. Gray iron jobbing shops throughout the central states, and malleable plants throughout the country are operating between 50 and 60 per cent of capacity.

Stock Piles Dwindle

Foundrymen whose stocks of iron and coke have been estimated as sufficient for sixty days or more, find that the increased melt is eating into reserves rapidly. As a result few find that they will have sufficient of materials on hand to last through September. Further, many have covered on their iron requirements only through the third quarter and now must buy on an ascending market. Southern No. 2 iron is selling as high as $25, Birmingham, while northern iron has more than kept pace, so that even with freight added, many large northern centers find the balance in favor of the southern grades. In New York and the New England states, foreign iron is being offered and purchased freely. Scotch, English, French and Belgian grades are being sold from $26.75 to $30, c.i.f., Boston or New York. During the week of Aug. 21, inquiries for foreign iron in the New York market totaled from 2000 to 3000 tons for prompt shipment and for deliveries over the next 30 to 60 days. About the same tonnage was sought by New England foundries.

Prices of Raw Material for Foundry Use

CORRECTED TO AUG. 24

Iron		Scrap	
No. 2 Foundry, Valley	$33.00 to 33.50	Heavy melting steel, Valley	$17.50 to 17.75
No. 2 Southern, Birmingham	22.00 to 24.00	Heavy melting steel, Pitts.	17.50 to 18.50
No. 2 Foundry, Chicago	30.00	Heav melting steel, Chicago	15.75 to 16.25
No. 2 Foundry, Philadelphia	32.13 to 34.02	Stove plate, Chicago	17.50 to 18.00
No. 2 Foundry, Buffalo	32.00 to 33.00	No. 1 cast, Chicago	21.50 to 22.00
Basic, Valley	28.00 to 30.00	No. 1 cast, Philadelphia	18.00 to 20.00
Basic, Buffalo	30.00	No. 1 cast, Birmingham	16.00 to 16.50
Malleable, Chicago	30.00	No. 1 cast, Buffalo	18.50 to 19.50
Malleable, Buffalo	33.00 to 34.00	Car wheels, iron, Pittsburgh	19.00 to 19.50
Coke		Car wheels, iron, Chicago	21.00 to 21.50
Connellsville foundry, coke	$13.00 to 14.00	Railroad malleable, Chicago	20.00 to 20.50
Wise county foundry, coke	13.50 to 14.50	Agricultural mal., Chicago	20.00 to 20.50
		Railroad malleable, Buffalo	18.00 to 19.00

Fuel Pinch Felt

Imports of Welsh coal along the Atlantic seaboard totaled 115,000 tons during the third week of August, while the demand indicated that this volume would be raised to about 200,000 tons per week within a short time. While foundry coke is scarce and difficult to obtain, the main effect of the fuel stringency is felt through the curtailed output of blast furnaces. Slight gains have been made in coke production since the strike agreement was signed in Cleveland, but the heavy foundry melt, coupled with comparatively light pig iron production and high prices are not conducive to a bright outlook for the foundries. A negative factor which may have some influence is curtailment in castings demand in some instances due to the inability of manufacturers, who use castings, to secure fuel. This is noteworthy in the case of automobile builders. The fact that the automotive industry does not come into the fuel preference classes under the interstate commerce commission order No. 23 points to an early reduction of operations. The Ford interests are said to have installed oil burning equipment where feasible and to have endeavored to arrange for Niagara power through Canada to evade impending stringency. Other large automobile and tractor plants in Michigan, Ohio, Wisconsin and northern Illinois are reported hard hit by coal scarcity.

Demand Spotted

In some directions castings demand grows steadily stronger. The Milwaukee plant of the International Harvester Co. is operating at 60 per cent of capacity. Agricultural implement sales are reported increasing. Exports, too, are greater than at any time since the period of depression started. According to the department of commerce, June exports totaled $217,690 greater for June than for May, marking an increase of 13.5 per cent over the preceding month. Exports for the 12 months ending June 30 showed a marked increase over the same period preceding. Cast iron pipe sales have continued strong throughout the season, contrary to the usual condition. Southern pipe foundries are active and an increase in price is scheduled. Building construction is proceeding with little slackening. Railway buying has slackened during the month, although during the week of Aug. 15, orders were placed for 2000 new freight cars in addition to a greater volume of repair work. Locomotive orders have kept pace with the purchase of rolling stock. The Lima Locomotive Works, Lima, O. is booked to capacity up to Jan. 1, while new additions to the plant are being constructed. On the basis of freight movement so far in 1922, an unprecendented strain upon the capacity of the railroads during the fall seems unavoidable. Delayed shipments of coal, coupled with the marketing of large crops seems inevitably to promise traffic difficulties. The railroads have improved their facilities, as has been noted during the year, but serious congestion seems to be impending nevertheless. Surplus freight cars showed a sharp drop during the last days of July.

Brass Shares Pick-Up

Brass and aluminum foundries have benefitted from the general activity in castings lines. The requirements for plumbing goods continue strong, while the orders from automotive and general machinery lines have reacted favorably upon nonferrous castings demand. Prices on nonferrous metals based on New York prices quoted by the *Daily Metal Trade* for Aug. 24 follow: Casting copper, 13.45c to 13.50c; electrolytic copper, 13.87½c; Straits tin, 32.25c; antimony, 5.25c; lead 5.90c; aluminum, No. 12 alloy, producers' price, 19.00c to 19.20c, and open market, 16.00c to 16.50c. Zinc is 6.25c, E. St. Louis, Ill.

Personal

J. W. Haynes, formerly foundry superintendent of the Wellston Mfg. Co., Wellston, O., is now in charge of the foundry of the Mahoning Foundry Co., Youngstown, O.

John C. Pangborn, vice president of the Pangborn Corp., Hagerstown, Md., has established his home and headquarters in Cleveland and will look after the Corporation's interests there.

Frank C. Schwoer, for many years associated with foundry interests in Indianapolis, has been made manager of production of the Brightman Mfg. Co., Columbus, O. His home is in Cleveland.

Charles J. Siegle, formerly connected with the Canton Steel Foundry Co., Canton, O., is now associated with the Queen City Foundry Co., Denver, Colo., which company makes both steel and gray-iron castings.

George E. King, for more than eight years connected with Denton & Anderson, Cleveland has organized the firm of George E. King & Co. to represent iron and steel firms in the Cleveland district. Among these firms is the Meadeville Malleable Iron Co., Meadeville, Pa.

A. R. Gould, St. Louis, for more than 20 years connected with the St. Louis Malleable Casting Co., has resigned, effective Sept. 1, as a director and general manager to become vice president and works manager of the Malleable Iron Range Co., Beaver Dam, Wis. F. W. Rogers, president and general manager of the Beaver Dam company, will divide duties with Mr. Gould.

R. S. Gildart, formerly director of publicity for the American Malleable Castings association, Cleveland, and previously, advertising manager for the P. B. Yates Machine Co., Beloit, Wis., and the Kelvinator Corp., Detroit, has been appointed advertising manager of the General Fireproofing Co., Youngstown, O. C. W. Noble, who has been advertising manager for several years, has been promoted and will conduct market investigations and special research work.

French Foundrymen Seek International Meeting

C. E. Hoyt, secretary of the American Foundrymen's association has received a formal invitation from the Association Technique de Fonderie de France to participate with the Institution of British Foundrymen and the Belgian Foundrymen's association in a comprehensive international foundrymen's congress and exhibition to be held in Paris under the auspices of the French association during the first two weeks next year September, 1923.

The French Foundrymen's association has been completely reorganized since the war and its membership now includes all of the prominent foundry industries in France. Through its efforts the Ministrere de l'Enseignement Technique has loaned the buildings of the Ecole Nationale d' Arts & Metiers at 151 Boulevard de l' Hopital where the convention and exhibition will be held. These buildings are particularly suited to this purpose. The school foundry which is completely equipped will be available for holding competitions and making demonstrations.

The invitations will be acted upon by the American Foundrymen's association at the next meeting of its board of directors in September and it is understood that arrangements will be made by the Amercian Foundrymen's association to insure adequate representation and attendance from the United States.

Electrochemists To Meet in Montreal

Final arrangements for the forty-second general meeting of the American Electrochemical society, at Montreal, Que., are being made. President Schluederberg will open the sessions on Thursday morning, Sept. 21, and the technical program will proceed with the presentation and discussion of papers on electrolysis and electroplating. The recently organized division on electrodeposition, of which G. B. Hogaboom is chairman and William Blum is secretary, will be well represented.

One of the papers of the Thursday morning session will deal with the physical properties of electrolytic iron—a product which is being made commercially, contrary to all predictions of 10 years ago. Papers on zinc, brass and other electro-deposited metals also will be given.

On Thursday afternoon and Friday morning, an interesting symposium on industrial heating will be in progress. The electrothermic division with Bradley Stoughton, chairman, and Colin G. Fink, secretary, which presented a most successful symposium on electric cast iron at the Baltimore meeting, in April, will again be in charge. Twelve papers specially prepared for this session and dwelling on industrial heating in electric furnaces, other than fusion and melting furnaces, will be offered.

Papers on the following subjects will be read: History of industrial heating; principles of design of furnaces; comparison of fuel costs in different types of electric furnaces, and with combustion furnaces; resistor materials; specific heats; electric conductivity of insulating materials at industrial furnace temperatures; heat emissivity; heat transfer.

An excursion to Shawinigan Falls has been arranged to afford members opportunity to inspect the various industrial plants of one of the most progressive centers on the continent. The headquarters for the meeting will be the Hotel Windsor, Montreal.

Siphonage Applied To Shop Ventilation

The need for an efficient ventilating system is felt by foundry operators as conditions in this industry are more severe than in many others. By eliminating the intense heat, smoke, steam and fumes from the foundry the efficiency of the workers is greatly increased. To assist in supplying a new ventilator manufactured by the Arex Co., Chicago, applying the siphonage principle to air movement has been designed. Made up of a

VENTILATOR WORKS BY NATURAL DRAFT

series of siphons surrounded by a frustum, it is so constructed that it is stated the winds from any direction exert a constant pulling force drawing out foul air, gases, steam and fumes. This ventilator does not employ a power driven fan and therefore, costs nothing to operate. The method in which the ventilator operates is simple and may be noted from the accompanying illustration.

Discontinues Converter

The Bayonne Steel Casting Co., Bayonne, N. J., is at present melting all its metal in an oil-fired basic open-hearth furnace, having recently closed its converter department and some time ago having sold its electric furnace.

August Sales Sustain Interest

Although Not as Active as the Preceding Month, the Demand Indicates Continued Increased Sales of Foundry Equipment—Replacement and Repair Orders Grow

ALTHOUGH activity has not been so great in the foundry equipment sales reported during August, the general tone of the market has been sound. Orders received have indicated a growing interest in labor saving machinery in line with the predicted scarcity of labor. Further, improved melt in practically all sections, has been followed by repair and replacement orders for molding and cleaning room equipment. A few sales of melting furnaces and annealing units are noted and the sales of ladles and supplies have been active. Foreign demand for foundry equipment has not been so great. During May, according to the department of commerce, over $75,000 worth of foundry molding machinery was shipped, more than $46,000 worth going to Ireland. Few new foundry ventures are reported, but extensions are providing a fair demand. The Ford Motor Co. is said to contemplate putting eight more molding floors into service at its River Rouge plant. Equipment from the Highland Plant foundry will serve partly to equip these new floors, but replacements will be needed and many new molding machines probably will be purchased. The American Malleable Co., Lancaster, N. Y. has awarded a contract to the Bonnot Co., Canton, O. for the installation of a pulverized coal system at its Owosso, Mich, plant. This installation will serve 24 annealing furnaces, three melting furnaces and two small boilers. Core ovens will be equipped later. The American Car & Foundry Co., Buffalo has purchased a 7-foot by 36-inch grinding mill from the Hardinge Co., New York, for grinding bituminous coal. The American Dressler Tunnel Kilns, Inc., Cleveland has closed a contract with the Bell City Malleable Iron Co., Racine, Wis. for an annealing oven for malleable castings. Dick Bros. Inc., Reading, Pa. have contracted with F. A. Coleman Co., Cleveland, for the installation of three core ovens.

Little New Construction in the East

TRADING in the eastern foundry equipment market is devoid of large orders. The few new foundry projects which are noted have not reached an active stage, and little work in the way of plant additions is now making demands on equipment manufacturers. This lack of new construction is atttributed in part to the advance of the building season and to the temporary unsettlement of business as result of rail and coal strikes. However, it is to be added, that foundry operations are being fairly well maintained. On an average, jobbing foundries in this district are running around 50 per cent, with pipe foundries and others engaged in special work operating virtually at capacity. With the exception of sand cutters, which appear in outstanding demand, the equipment now being moved is more in the nature of supplies, such as flasks, binders and other material. Demand for conveying equipment is less active, only a few scattered sales being reported, including an Orton & Steinbrenner crane, for the Buffalo plant of the American Car & Foundry Co. and a 5-ton Niles-Bement-Pond electric crane, with 25-foot span, for the Utica Heater Co., Utica, N. Y. The Farrell Foundry & Machine Co., Ansonia, Conn., has withdrawn its inquiry for a 5-ton electric crane, and will shortly bring out new specifications. Included in new incorporations in this district is the Flower City Pipe & Iron Corp., Rochester, N. Y., with a capitalization of $50,000

Diversified Demand in Chicago

ACTIVITY in equipment sales to foundries in the west continues to be noted by engineers and manufacturers in the Chicago district. Demand for ladles is an index of foundry operation and demand for this class of goods ranges from small hand ladles to large geared or crane ladles. These are being bought by all classes of foundries and over a wide area, indicating the melt is at least holding its own. The Whiting Corp., Harvey, Ill., has booked a 10-ton hand power crane of 36-foot span for the Santa Fe railroad at San Bernardino, Cal., five 1-motor 7½ ton jib cranes for the new open hearth plant of the Wisconsin Steel Co. at South Chicago, and a 65-ton crane for the Western States Gas & Electric Co., Placerville, Cal. The same concern has booked a No. 5 cupola, 40-feet high, for the Frog & Switch Mfg. Co., Carlisle, Pa. The new foundry at Pullman, Ill., for the Pullman Co., is to be a continuous car wheel foundry with mechanical sand handling and other labor saving devices, with a capacity of 500 wheels per day or one per minute. This foundry is designed and supervised by Frank D. Chase, Inc., Chicago. The same engineer has been retained by the Iron City Sanitary Mfg. Co., Pittsburgh, to develop plans for a new bathtub foundry. The Bucyrus Co., Milwaukee, has bought a Moore type electric furnace from the Pittsburgh Electric Furnace Corp., Pittsburgh. This furnace will have 1½-tons capacity and is for the steel foundry addition the company is erecting. Cribben & Sexton, stove founders, Chicago, are adding an enameling department in connection with their foundry.

Need Pittsburgh Buying

PRODUCERS and sellers of foundry equipment in the Pittsburgh district report retarded orders during the past two weeks, but the opinion freely expressed is that the undertone of the market continues sound. The shortage of labor with which foundry owners have been confronted during the last two months, has affected materially the placing of business. Sales negotiated recently have been of a miscellaneous character and reflect the absolute need of the buyer. Core ovens have shared largely in the week's purchases. While inquiry for molding machines generally has been light during the fore part of August, a slight increase in this direction is noticeable at the moment. However, sellers of this type machine report negotiations have resulted in no sales. Three good sized contracts for flasks now are pending with signatures anticipated in time to include the sales in this month's business. Equipment of miscellaneous character desired by the American Manganese Steel Co., the Oil Well Supply Co., Lima Locomotive Co., and the Westinghouse Electric & Mfg. Co. has been awarded among various makers. Demand for crucibles has been slack during the past two

weeks, but is somewhat steadier now. Foundries are working on narrow profits on account of the fuel situation and hence little disposition is shown to make expenditures for new equipment. Numerous crane deals are pending but purchasers appear to be in no hurry to close. Current inquiry includes a 7½-ton overhead crane. Buying of various foundry supplies is increasing in the experience of several dealers as reserves on hand when activity was resumed have been exhausted. On the whole the foundry supply business at Chicago is showing unmistakable signs of resumption of general trading and indicate that foundries are increasing their melt each month.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

A 1-story, 84 x 110-foot addition will be erected by the Essex Foundry Co., Newark, N. J.

The plant of the Marion Machine & Foundry Co., Mexia, Tex., recently was damaged by fire. The loss was estimated at $65,000.

The American Well & Prospecting Co., Corsicana, Tex., plans a pattern shop addition, 50 x 100 feet.

W. W. Rosebraugh, Salem, Oreg., plans to rebuild his machine shop, foundry and boiler works, recently damaged by fire.

Kay & Brunner, 2714 Frederick street, Los Angeles, operating a foundry, have had plans prepared for a 1-story addition.

Orr & Sembower, Inc., Reading, Pa., plan to rebuild the part of their brass foundry, which was recently damaged by fire.

Work has been started on an addition to the plant of the American Foundry & Furnace Co., Bloomington, Ill.

Recently organized, the Barberton Machine & Foundry Co. has started the erection at Barberton, O., of a $25,000 factory. The building will be ready for use in about 90 days.

Damage to the extent of several thousand dollars was done by fire to the plant of the Galt Malleable Iron Co., Galt, Ont., Canada. Rebuilding operations have already commenced.

The McGann Mfg. Co., York, Pa., castings manufacturer, has been incorporated with $100,000 capital stock by William J. Kuntz, and others.

The Reliance Stove & Mfg. Co., Pittsburgh, has been incorporated with $15,000 capital stock, by John Fischer, H. H. Feldman and S. N. Fischer.

The McChesney Foundry & Mfg. Co., El Paso, Tex., capitalized at $35,000 has been incorporated by L. P. McChesney, W. S. Dobie and S. J. Isaacks.

A new brass foundry and machine shop costing about $20,000 is being erected by the Nekoosa Motor & Machine Co., Nekoosa, Wis. It replaces the plant destroyed by fire early in July.

The George Fuller's Sons, Inc., Hallowell, Me., has been incorporated to operate a general foundry and machine shop with $25,000 capital by Ernest I. Gedney, who is president and treasurer, and Fremont J. C. Little, clerk.

The plant of Jewett & Co., Buffalo, manufacturers of stoves, suffered a loss by fire Aug. 10, estimated at $200,000. Two buildings were destroyed and three were damaged. Considerable machinery and stock was ruined.

A charter has been granted to the Mid-West Die Casting Co., Milwaukee, organized by A. E. Rathgen, Ed C. Schneider and Waldemar C. Wehe, attorney, 425 East Water street. The capital stock is $15,000.

The Schuessler Foundry Co., Alton, Ill., has awarded contract to Decatur Bridge & Iron Co. for a new foundry. The main building will be 120 x 230 feet. Other buildings will be erected later. A. J. Schuessler is the owner.

Fraher Brass Works, Inc., 14 South Jefferson street, Chicago, has been incorporated at $10,000 to operate a brass and iron foundry. The incorporators are L. L. Richmond, Thomas P. Dudley Jr., and Lowell A. Lawson. The correspondent is Ryan, Condon & Livingston, 1600 First National Bank building.

The Crucible Steel Castings Co., Cleveland, has awarded contract to the Sam W. Emerson Co. for construction of a new plant, 102 x 240 feet, steel and brick, to replace one now occupied on site of proposed union station. The new plant will be at Almira avenue and West Eighty-fourth street.

The Nelson Pulley Co., Seventy-seventh avenue and Burnham street, West Allis, Wis., has reopened its grey iron foundry and putting a small force of men at work in its machine shop, due to the improvement in orders. S. G. Harrison has recently joined the concern as sales manager.

The Planet Piston Corp., Belleville, Ill., capitalized at $50,000, has been organized to manufacture aluminum alloy pistons for automobile engines. Among the incorporators are Stephen D. Hartog, Charles Procasky, Herman G. Wangelin, Richard W. Hilgard and Albert Sprich, all of Belleville.

The Commercial Engine Co., 2424 Porter street, Los Angeles, has increased its capital stock from $75,000 to $200,000 and will change its name to the Commercial Iron Works. It recently purchased the Ohio Foundry, Inc., Vernon, Cal., and is erecting a foundry building, 90 x 164 feet.

Conversion of the present gray iron foundry into an extension of the machine shop, and the erection of a foundry building, 40 x 120 feet, is the plan being put into effect by the Gilson Bros. Co. of Fredonia, Ozaukee county, Wis., manufacturer of concrete mixers, corn shredders, silage machinery and does a jobbing foundry business. The work will cost about $35,000 to $40,000.

Representatives of the Fitchburg Pumping Machinery Co., Fitchburg, Mass., after conferring at Akron, O., with the officers of the newly organized Ohio Pumping Machinery Co., announced that work will be commenced within the next 60 days on the erection of the company's proposed plant in East Akron, O. The company has obtained a site of four acres on which it plans the plant which will be erected at an estimated cost of $125,000.

Work has been started by the Belle City Malleable Iron Co., Racine, Wis., on the first divisions of an important plant enlargement plan which will require a year to complete and will cost about $750,000. The annealing building will be extended 260 feet on the site of the present office building, and an administration building will be erected. The annealing ovens will be furnished by the American Dressler Tunnel Kilns Co. The construction work has been placed with Nelson & Co., general contractors, of Racine.

The Carlin Foundry Corp. is being formed by George E. Carlin, Alex A. Stewart and John Freise to purchase the plant of the Northern Foundry Co. at Laporte, Ind. The new company will specialize in light gray iron castings for the jobbing trade. The members of the company have had long experience in the foundry industry in the Chicago district, being employed for many years by large foundry interests. The foundry is well equipped and is expected to start operation about Sept. 1.

New Trade Publications

TOOLS—Moore & Moore, Inc., Reading, Pa., has issued a new 243-page catalog illustrating and giving information on a complete line of stock tools as well as some special tools manufactured by that company. The book is divided into eight sections: first, reamers including mandrels, shell reamer arbors, etc.; second, reamers, sized according to the metric scale; third, drills, co-bores, sleeves and sockets; fourth, milling cutters, shell mill arbors; fifth, milling cutters, high power special tools; sixth, taps, standard and millimeter; seventh, dies, die stocks, wrenches and screw plates; eighth, useful information. This last section contains several pages of tables such as decimal equivalents, standard dimensions for hand taps, thread dimensions and tap drill sizes.

LEAD WELDING AND BATTERY REPAIR—The Bastian Blessing Co., West Austin avenue at La Salle street, Chicago, has issued an illustrated folder dealing principally with the use of the oxyacetylene torch in lead welding.

DRINKING WATER—Armstrong Cork & Insulation Co., Pittsburgh, has issued a small illustrated folder explaining the importance of having the proper drinking water systems in industrial plants not only as a sanitary necessity but to prevent waste of time and money.

PORTABLE FURNACES—The Mayor Fuel-Saving Furnace Co., 935 Addison road, Cleveland, is circulating a leaflet in which a self-contained portable furnace is described and illustrated. This may be used with an oven already installed with but a few changes, or it may be connected with a specially built one. It is said that this furnace will heat ovens up to 2500 cubic feet in volume. Because of a forced draught it is claimed that coke, gas coke, or coke breeze with a little coal added may be used. It is also stated that they will burn fuel oil, producers gas or natural gas.

GRINDING—The Norton Co., Worcester, Mass., has published an 8-page leaflet describing and illustrating the constantly increasing use of the grinder in modern manufacturing. Detailed accounts are given of the many uses for grinding machines.

HEATING SYSTEMS—F. J. Ryan & Co., Philadelphia, have issued a leaflet entitled "Electric Heat—What Is It?" This is the first of a series of articles published under the name of Common Sense Talks. In this folder many of the so called mysterious qualities of electric heating are carefully explained.